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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

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| IN THE MATTER OF: | ) | |
| | ) | |
| JOHNS-MANVILLE SALES CORPORATION, WAUKEGAN, ILLINOIS | ) | U.S.E.P.A. Docket No. |
| | ) | |
| Proceeding Under Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §9606(a) (1980) | ) | |

**ADMINISTRATIVE ORDER BY CONSENT**

The signatories to this Administrative Order By Consent ("Consent Order"), by their respective attorneys, having agreed to the entry of this Consent Order,

THEREFORE, It is Ordered, Adjudged, and Decreed that:

## I. JURISDICTION

This Consent Order is issued pursuant to the authority vested in the President of the United States by Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), 42 U.S.C. §9606(a), and delegated to the Administrator of the United States Environmental Protection Agency ("USEPA") on August 14, 1981 by Executive Order 12316, 46 Fed. Reg. 42237 (Aug. 20, 1981), who duly redelegated the authority to the Regional Administrator of Region V, USEPA on April 1, 1983.

## II. DESCRIPTION OF SITE

Johns-Manville Sales Corporation ("Johns-Manville") owns and operates a facility on Greenwood Avenue in Waukegan, Illinois ("Waukegan facility"). The Waukegan facility was constructed beginning in 1919 and ending in 1923. Since it began operations, the Waukegan facility has produced a variety of building materials comprised of a variety of substances. In operating, waste was and is generated, consisting of such things as trim and rejects from the finished products and of materials unused in the manufacturing process. Included among the waste generated at the Waukegan facility over the years are hazardous substances as defined by Section 101(14) of CERCLA, 42 U.S.C. §9601(14), and other wastes, including asbestos, chromium, lead, xylene and thiram.

Much of the waste has been disposed of in the Waukegan facility's onsite disposal area ("Disposal Area"). The Disposal Area covers approximately 120 acres of land that was formerly marsh land. The Disposal Area presently consists of four general waste disposal areas - the friable asbestos disposal pit, the scrap disposal area, the wet waste basin system composed of a series of settling basins, and the sludge disposal area.

While a precise volume of waste disposed at the Disposal Area cannot be ascertained due to the long history of operations and lack of records for the earlier years, it is estimated that nearly 600,000 tons of asbestos-containing waste and raw asbestos waste have been disposed of at the Disposal Area.

The Disposal Area is bordered on the west by the buildings erected at the Waukegan facility, on the south by Commonwealth Edison Company's Waukegan Station, on the east by Lake Michigan and on the north by the Illinois Beach State Park.

In December, 1973 and April, 1982, contractors for USEPA collected air monitoring data to determine the impact of asbestos disposal practices at the Waukegan facility on the ambient air. Based on the results of the air monitoring studies and the potential for surface and ground water contamination, the Disposal Area was included, over the objections of Johns-Manville, in the National Priorities List promulgated by USEPA on September 8, 1983 as Appendix B to the National Oil and Hazardous Substances Contingency Plan, 48 Fed. Reg. 40658 (Sept. 8, 1983), and is a candidate for response action by USEPA under CERCLA.

The Regional Administrator, USEPA, has determined but Johns-Manville does not acknowledge that: (1) the Waukegan facility is a "facility" as defined in Section 101(9) of

CERCLA; (2) Johns-Manville is a "person" as that term is defined in Section 101(21) of CERCLA; (3) "hazardous substances" as defined by Section 101(14) of CERCLA have been disposed at the Waukegan facility; (4) the release and threatened release of hazardous substances into the air, groundwater and surface water adjacent to the Waukegan facility constitutes a "release or threat of release" as that term is defined in Section 101(22) of CERCLA, which may present an imminent and substantial endangerment to public health or welfare or the environment; (5) Johns-Manville is a "responsible person" within the meaning of Section 107 of CERCLA; and (6) the actions to be taken pursuant to this Consent Order are reasonable and necessary to protect the public health or welfare and the environment.

A reasonable time period for beginning and completing the actions required by this Consent Order has been provided for, and Johns-Manville has agreed to undertake the actions requested by the USEPA in this Consent Order. The Signatories agree that the Work to be undertaken pursuant to this Consent Order is appropriate for determining the appropriate extent of response authorized by CERCLA and is not inconsistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

## III. Signatories

This Consent Order shall apply to and be binding upon the Signatories Johns-Manville and USEPA, their officials, officers, directors, agents, principals, servants, employees, successors, and assigns, and upon all persons, firms, and corporations acting under or for the parties, including subsidiaries and divisions of Johns-Manville. Each undersigned representative of a Signatory to this Consent Order certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Order and to legally bind such Signatory to this document.

## IV. WORK TO BE PERFORMED

A. The following Work shall be performed by Johns-Manville at the Disposal Area:

1. Initial Remedial Measures: Within 45 days of the effective date of this Consent Order, Johns-Manville shall install along the perimeter of the Disposal Area, if they are not already in place, warning signs which satisfy the requirements of 40 C.F.R. §61.25 (1983). These warning signs will be displayed at the locations identified in Exhibit 2C.

2. Water Balance Study: Johns-Manville has undertaken a study of the water used in its operation of the Waukegan

facility in an effort to determine whether, and if so where, there is any loss of process waste water to the environment ("Water Balance Study"). The Water Balance Study will be considered, along with the Remedial Investigation/Feasibility Study which is to be performed, in developing, screening, and selecting pursuant to the applicable provisions of 40 C.F.R. §300.68 (1983) the Remedial Action Alternative for the Disposal Area. Johns-Manville shall complete the Water Balance Study by April 17, 1984 and shall submit to USEPA a final report concerning the means by which the Water Balance Study was undertaken and the conclusions drawn from it.

3. Remedial Investigation/Feasibility Study: Johns-Manville shall conduct a Remedial Investigation ("RI") and Feasibility Study ("FS") at the Disposal Area which will implement the following tasks:

(a) An air monitoring study to determine the extent to which airborne asbestos concentrations are elevated at the Disposal Area compared to background levels and the exposure potential for residents of surrounding areas as described in Exhibit 1 attached hereto.

(b) Johns-Manville has prepared the Specifications for Geotechnical and Hydrological Investigation attached hereto as Exhibit 2, and the drawings described in paragraph 1.1 of Exhibit 2 and attached hereto as Exhibits 2A through 2C. These documents were submitted to USEPA for approval on or about February 20, 1984. Once the documents are approved by USEPA, the work described therein will commence.

(c) Upon completion of the work described in paragraphs (a) and (b) above, Johns-Manville shall prepare a RI report, as described generally in paragraph A of Exhibit 3 attached hereto. The RI report shall be submitted to USEPA for approval within 180 days of the effective date of this Consent Order.

(d) Upon approval of the RI report, Johns-Manville will undertake an "Alternative Remedial Actions Evaluation," as described generally in paragraph B of Exhibit 3 attached hereto.

(e) Johns-Manville will compile and describe in a FS report the methods, results, and conclusions of the Alternative Remedial Actions Evaluation undertaken. The FS report shall include generally the items described in paragraph C of Exhibit 3 attached hereto and shall recommend a selected remedial alternative ("Recommended Remedial Action Alternative"), as described by 40 C.F.R. §300.68(j) (1983). This recommendation shall include appropriate provisions for deed notice and future maintenance of the property. The FS report shall be submitted to USEPA for approval within 90 days of approval by USEPA of the RI report. Approval of the RI or FS reports may depend upon the gathering of additional data or further engineering evaluations. Where additional data or evaluations are requested, USEPA shall so notify Johns-Manville and provide Johns-Manville with a time schedule for submission of such data. Johns-Manville shall thereafter gather the data or proceed in accordance with the dispute resolution provisions of paragraph V of this Consent Order.

(f) USEPA and Johns-Manville agree to promptly and in good faith enter into negotiations for the purpose of reaching agreement on the Recommended Remedial Action Alternative as described by 40 C.F.R. §300.68(j)(1983) to be proposed to be undertaken by Johns-Manville at the Disposal Area. Any agreement reached by USEPA and Johns-Manville will be embodied in an administrative order by consent subject to appropriate opportunity for public comment and approval.

B. Exhibits 1, 2, 2A through 2C, and 3 attached hereto and documents, reports, and schedules developed pursuant to this Consent Order are integral parts of this Consent Order and are hereby incorporated by reference as though set forth verbatim.

C. The RI/FS shall be conducted in conformance with and shall be evaluated by USEPA for approval in accordance with the applicable provisions of 40 C.F.R. §300.68 (1983).

D. USEPA certifies that the Work approved by USEPA is consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

## V. COMMENCEMENT AND COMPLETION OF WORK AND PROGRESS REPORTS

A. Subject to obtaining any necessary permits, Johns-Manville shall commence the Work as provided in paragraph IV of this Consent Order. The Work shall be completed in accordance with the standards, specifications, and the schedule of completion contained in paragraph IV of this Consent Order. Johns-Manville shall obtain all necessary permits as expeditiously as possible.

B. Johns-Manville shall provide to USEPA written progress reports which describe the actions which have been taken toward achieving compliance with this Consent Order during the previous month as well as actions which are scheduled for the next month. These progress reports are to be submitted to USEPA by the tenth day of every month following the effective date of this Consent Order, unless otherwise agreed to by the Signatories.

C. 1. Johns-Manville shall submit to USEPA for approval the Work upon its completion according to the schedule contained in paragraph IV of this Consent Order. USEPA shall review the Work and indicate its approval or disapproval of the Work within thirty days of receipt of the Work submitted.

2. In the event the Work is disapproved in whole or in part, USEPA shall timely notify Johns-Manville in writing as to what it believes should be done to complete the Work, a statement of why such is needed to complete the Work, and a proposed schedule therefor.

3. A decision to approve the Work shall be based upon whether the Work has been completed in accordance with the

standards and specifications described in paragraph IV of this Consent Order and whether the Work is consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

4. If Johns-Manville does not object to the corrective measures, if any, proposed by USEPA within thirty days after receiving written notice, Johns-Manville shall expeditiously undertake and complete such measures in accordance with the proposed schedule of completion.

5. If Johns-Manville objects to any proposed corrective measures, Johns-Manville shall, within thirty days after receiving written notice, notify USEPA of its objections and the reasons therefor.

6. Any issue not reconciled by agreement of the Signatories to this Consent Order within thirty days from the date upon which Johns-Manville notifies USEPA of any such objections, shall be deemed resolved in favor of USEPA and the changes made by USEPA shall become part of the Consent Order as specified in paragraph 1 above. USEPA agrees to attempt to reconcile any disagreements with Johns-Manville and to negotiate such attempts in good faith.

7. Johns-Manville waives any right it may have to contest or adjudicate the validity of any term in this Consent Order, except any terms adopted pursuant to paragraph 6 above

or otherwise expressly reserved herein. Johns-Manville may challenge any term adopted pursuant to paragraph 6 above in any action brought by USEPA to enforce the term or in any action brought by Johns-Manville to contest the term.

D. Documents, including progress reports and approvals, to be submitted to the Signatories shall be sent by certified mail return receipt requested, to the following addresses or to such other address as the Signatories hereafter may designate in writing:

1. Those documents to be submitted to USEPA should be sent in duplicate to:

Director, Waste Management Division
USEPA, Region V
230 South Dearborn Street
Chicago, Illinois 60604

2. Those documents to be sent to Johns-Manville should be sent to:

Stephen V. Moser, Esq.
Manville Service Corporation
Ken-Caryl Ranch
P.O. Box 5723
Denver, Colorado 80217

K. Nerheim
Manville Service Corporation
Ken-Caryl Ranch
P.O. Box 5108
Denver, Colorado 80217

E. If the date for submission of any item or notification required by this Consent Order falls upon a weekend or state or federal holiday, the time period for submission of that item or notification is extended to the next working day following the weekend or holiday.

## VI. DELAY IN PERFORMANCE; STIPULATED PENALTIES

A. Johns-Manville shall pay into the Hazardous Substances Response Trust Fund administered by USEPA the sums set forth below as stipulated penalties for each week that Johns-Manville fails to submit a report or document in accordance with the requirements contained in this Consent Order.

The provisions that are subject to stipulated penalties are as follows:

1. Paragraph IV(A)(2), submission of Water Balance Study Report;

2. Paragraph IV(A)(3)(c), submission of Remedial Investigation Report;

3. Paragraph IV(A)(3)(e), submission of Feasibility Study Report;

4. Paragraph V(B), submission of Written Progress Reports.

These stipulated penalties shall accrue in the amount of $1,000.00 for the first week and $2,000.00 for each week thereafter only for a period of one month unless USEPA has provided Johns-Manville with written notice of a failure to make such submissions.

B. Johns-Manville shall notify USEPA within twenty days of any delay caused by circumstances beyond the control of Johns-Manville which occurs in the performance of the Work or the submission of reports required under this Consent Order. Such notification shall be in writing and shall describe fully the nature of the delay, the reasons therefor, the expected duration of the delay, the actions which will be taken to mitigate further delay, and the timetable by which the actions in mitigation of the delay will be taken. Johns-Manville will adopt all reasonable measures to avoid or minimize any such delay.

C. Any failure by Johns-Manville to complete properly the Work or submit reports which result from circumstances beyond the control of Johns-Manville shall not be deemed to be a violation of its obligations under this Consent Order nor shall it make Johns-Manville liable for the stipulated penalties contained in paragraph VI(A) of this Consent Order. To the extent delay is caused by such circumstances beyond the control of Johns-Manville, the time for performance hereunder shall be extended.

D. In the event Johns-Manville and USEPA cannot agree that the time for performance shall be extended, the dispute shall be resolved in accordance with the provisions of paragraph V of this Consent Order except that Johns-Manville shall have the burden of proving that the delay was caused by circumstances beyond the control of Johns-Manville.

E. The stipulated penalties set forth in subparagraph VI(A) above shall not preclude USEPA from electing to pursue any other remedies or sanctions, including a suit for statutory penalties up to the amount authorized by law, which may be available to USEPA by reason of Johns-Manville's failure to comply with any requirements of this Consent Order. However, in the event that Johns-Manville fails to submit the reports described in subparagraph VI(A) above, USEPA shall only be able to seek the stipulated penalties set forth in that subparagraph for those violations unless Johns-Manville repeatedly or in bad faith fails to submit the reports described in subparagraph VI(A) above. In that event, USEPA may seek other remedies or sanctions, including statutory penalties up to the amount authorized by law, for those violations.

## VII. ACCESS TO THE DISPOSAL AREA

USEPA and its authorized representatives shall have access to the Disposal Area at all reasonable times in order to observe and monitor the progress of the Work, to take samples from and to inspect the Disposal Area, and to inspect records relating to the performance of the Consent Order as provided in Section 104(e)(1) of CERCLA.

## VIII. PROJECT COORDINATORS

A. Johns-Manville and USEPA shall each designate a Project Coordinator for the purpose of overseeing the implementation of this Consent Order. To the maximum extent possible, except as specifically provided in this Consent Order, communications among Johns-Manville and USEPA concerning the terms and conditions of this Consent Order shall be made between the Coordinators.

B. Within fifteen (15) days of entry of this Consent Order, the Signatories shall notify each other, in writing, of the name, address and telephone number of the designated Project Coordinator and of any Alternate Project Coordinator.

C. Each Project Coordinator shall be responsible for assuring that all communications from the other are appropriately disseminated and processed.

D. The Project Coordinator for USEPA ("OSC") shall have the authority vested in an on-scene coordinator by 40 C.F.R. Part 300 (1983), including authority to require Johns-Manville to cease performance of the Work or any portion thereof which in the opinion of the OSC, may or does present or contribute to an endangerment to public health, welfare or the environment. In the event the OSC does require such cessation of the Work, the OSC then shall have the authority to require Johns-Manville to perform the Work consistent with paragraph IV of this Consent Order in accordance with the instructions of the OSC to avoid or mitigate the endangerment, which he or she believes may occur. If Johns-Manville objects to any order requiring cessation of the Work or to any order to perform the work in accordance with the instructions of the OSC, Johns-Manville may petition a court with competent jurisdiction to stay or set aside the order of the OSC.

E. The Project Coordinator for Johns-Manville or any of the Alternate Project Coordinators for Johns-Manville, shall be on-site during all hours of work and shall be on call for the pendency of this Consent Order.

F. The Regional Administrator of Region V, USEPA or his designee shall have the authority to extend the time period for implementation or completion of an item of Work described in paragraph IV of this Consent Order for a period not to exceed fifteen additional working days without need for modification of this Consent Order for each event or occurrence for which Johns-Manville demonstrates that such extension is necessary. Extensions of time shall be documented in writing.

## IX. SAMPLING AND ANALYSIS

USEPA and Johns-Manville shall make available to each other and to IEPA the results of sampling, tests, or other data generated by them, or on their behalf with respect to implementation of this Consent Order. At the request of either USEPA or Johns-Manville, the one shall provide the other with split or duplicate samples of any samples taken during the implementation of this Consent Order. If the OSC has notified Johns-Manville in writing that USEPA wishes to obtain split or duplicate samples or otherwise to observe and comment on any Work to be performed at the Disposal Area, Johns-Manville shall notify the OSC at least three working days in advance of the performance of the Work about which such notification has been received.

## X. RETENTION AND AVAILABILITY OF INFORMATION

Johns-Manville shall retain during the pendency of this Consent Order and for a period of six years after its termination, all records and documents in its possession, custody, or control which relate to the performance of this Consent Order. Notwithstanding any other provisions of this Consent Order, USEPA and Johns-Manville retain whatever rights they may have under applicable statutes, laws, and regulations governing the production of records and documents; in particular, USEPA retains the right to inspect records relating to the performance of the Consent Order as provided in Section 104(e)(1) of CERCLA.

## XI. COMPLIANCE WITH ALL LAWS

All work undertaken by Johns-Manville pursuant to this Consent Order shall be performed in compliance with all applicable federal and state laws and regulations. Johns-Manville shall be responsible for obtaining all federal, state, or local permits which are necessary for the performance of the Work. USEPA shall expedite the processing of the permits required under its authority.

## XII. PARTICIPATION IN COMMUNITY RELATIONS ACTIVITIES

Johns-Manville shall be given notice of and provided with the opportunity to participate in any public meetings which may be held or sponsored by USEPA to explain activities at or concerning the Disposal Area, including, without limitation, the findings of the RI/FS. To the extent practicable, USEPA shall consult with Johns-Manville in setting the dates and times of such public meetings.

## XIII. REIMBURSEMENT OF RESPONSE COSTS

A. Within thirty days of the effective date of this Consent Order, Johns-Manville shall pay to USEPA the sum of $43,735.00 as reimbursement of response costs incurred by USEPA from August 26, 1982 through March 1, 1984. Payment shall be made to the order of the Hazardous Substances Response Trust Fund. Payment shall be forwarded to USEPA, Region V, Regional Hearing Clerk, 230 South Dearborn Street, Chicago, Illinois 60604. USEPA reserves its right to petition the United States Bankruptcy Court for payment of the response costs incurred by USEPA prior to August 26, 1982. Johns-Manville agrees to reimburse USEPA for the response costs incurred from August 26, 1982 through March 1, 1984 because of the specific facts and circumstances which relate to this Consent Order. Johns-Manville's agreement does not constitute nor is it to be construed as precedent for any agreement to pay response costs or for what constitutes response costs pursuant to CERCLA at any other site or location nor as precedent for what will constitute response costs for which Johns-Manville is liable pursuant to paragraph XIII(B) of this Consent Order and to Section 107(a) of CERCLA.

B. Within thirty days of the end of each calendar year, USEPA shall provide Johns-Manville with a full accounting and explanation of the response costs incurred by USEPA in connection with the Disposal Area during the previous year. Within thirty days of receipt of this accounting and explanation, Johns-Manville will advise USEPA in writing as to whether or not it considers these costs to be necessary and consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983), and to be costs for which Johns-Manville is liable pursuant to Section 107(a) of CERCLA. Johns-Manville shall reimburse USEPA for all costs associated with USEPA's activities in connection with the Consent Order that are not inconsistent with the National Oil and Hazardous Substances Contingency Plan.

## XIV. COVENANT NOT TO SUE

To avoid adjudication between the Signatories hereto and the expense that would be incurred in connection with such adjudication, and to set to rest the differences existing among them based on information known to the parties when settling this matter, USEPA has determined that full performance of the commitments made in this Consent Order constitutes full satisfaction of any and all civil claims which USEPA may have against Johns-Manville with respect to the performance of Remedial Investigations and Feasibility Studies pursuant to Section 104(a) and (b) of CERCLA and

40 C.F.R. Part 300, concerning the possible contamination at and from the Waukegan facility addressed in the scope of this Consent Order (hereinafter collectively referred to as the "Covered Matters") and USEPA hereby covenants not to sue, execute judgment, or take any civil, judicial or administrative action, under common law (federal or state), federal, state or local law, or any statutes administered or enforced by USEPA against Johns-Manville, its subsidiaries, divisions, parents, affiliates, or their respective directors, officers, employees, agents, successors and assigns arising out of or related to the Covered Matters. Except with respect to Covered Matters, this Consent Order does not release Johns-Manville from responsibility or liability for response actions at the Disposal Area or any other responsibilities or liabilities under Sections 104, 106, or 107 of CERCLA or any other provisions of CERCLA or any other Federal or State law; nor does this Consent Order release Manville from any responsibility or liability it may have to maintain the Waukegan facility in an environmentally safe manner during the pendancy of and following the termination and satisfaction of this Consent Order. USEPA is specifically without authority to waive any natural resources claims which the United States may have under Section 107(a)(4)(c) and (f) of CERCLA. It is not the purpose of this agreement nor the

intentions of the Signatories to release any other persons or entities not parties to this Consent Order from any claims or liabilities which they may have.

## XV. TERMINATION AND SATISFACTION

The provisions of this Consent Order shall be deemed satisfied upon Johns-Manville's receipt of written notice from USEPA that Johns-Manville has demonstrated that all of the terms of the Consent Order have been completed. Following completion of the whole or any subpart of the Consent Order, Johns-Manville may request a determination by USEPA as to whether Johns-Manville has completed the whole or any subpart to the satisfaction of USEPA. USEPA shall provide Johns-Manville with such a determination within 30 days of the request by Johns-Manville.

## XVI. CREATION OF ENDANGERMENT

In the event that the Regional Administrator of Region V, USEPA determines that activities implementing or in non-compliance with this Consent Order or any other circumstances or activities are creating an imminent and substantial endangerment to the health and welfare of the people on the Site or in the surrounding area or to the environment within the meaning of Section 106 of CERCLA, the Regional Administrator of Region V, USEPA may order Johns-Manville to stop further implementation of this Consent Order for such period of time as needed, and may order Johns-Manville to take whatever actions are necessary to abate the endangerment or may petition a court of competent jurisdiction for such an order. During this time, Johns-Manville's obligations pursuant to this Consent Order shall be suspended and the time schedule for implementation shall be extended by the time period of the delay.

## XVII. OTHER CLAIMS

Johns-Manville agrees to indemnify and save and hold harmless USEPA from any and all claims or causes of action arising from negligent acts or omissions or willful misconduct of Johns-Manville in carrying out the activities pursuant to this Consent Order, except for worker compensation claims by Federal employees. USEPA shall notify Johns-Manville of any such claims or action within twenty working days of receipt by USEPA of such a claim or action. USEPA agrees not to act with respect to any such claim or action without first providing Johns-Manville an opportunity to participate. USEPA further agrees to cooperate with Johns-Manville in the defense of any such claim or action.

USEPA shall not be held liable under or as a party to any contract entered into by Johns-Manville in carrying out the activities pursuant to this Consent Order.

## XVIII. RESERVATION OF RIGHTS

A. Except as expressly provided in this Consent Order, Johns-Manville and USEPA expressly reserve all rights and defenses that they may have, including USEPA's right to disapprove the Work performed by Johns-Manville as provided in this Consent Order in which event USEPA will have the right to undertake its own remedial investigation, feasibility study, and remedial action and to seek reimbursement from Johns-Manville thereafter for such costs incurred by the Hazardous Substances Response Trust Fund.

B. Nothing herein shall be construed to release Johns-Manville from liability, if any, that it may have with respect to matters other than Covered Matters.

C. Johns-Manville, in entering into this Consent Order does not admit, accept, or intend to acknowledge any liability or fault with respect to any matter arising out of or relating to the Disposal Area or the Waukegan facility.

## XIX. PUBLIC COMMENT, APPROVAL OF THE COURT AND THE EFFECTIVE DATE OF CONSENT ORDER

A. Within 30 days of the date of signature by Johns-Manville and USEPA of this Consent Order, Johns-Manville shall petition the United States Bankruptcy Court for approval to enter into this Order.

B. USEPA shall simultaneously announce the availability of this Consent Order to the public for review and comment. USEPA shall accept comments from the public for a period of thirty days after such announcement. If sufficient interest warrants, as determined by USEPA, a public meeting will be held. At the end of the comment period, USEPA shall review all such comments and shall either:

1. Determine that the Consent Order should be made effective in its present form, in which case Johns-Manville shall be so notified in writing; or

2. Determine that modification of the Consent Order is necessary, in which case Johns-Manville will be informed as to the nature of all required changes. If Johns-Manville agrees to the modifications, the Consent Order shall be so modified.

C. In the event that Johns-Manville is unwilling to agree on modifications required by USEPA as a result of public comment, this Consent Order may be withdrawn by USEPA. In such an event, USEPA reserves all rights to take such actions as it deems necessary, and Johns-Manville reserves all rights to contest such actions.

D. In the event that the Signatories agree on the final form of this Consent Order, the Consent Order shall become effective upon signature of USEPA and Johns-Manville and approval of the United States Bankruptcy Court.

IT IS SO AGREED:

By: ______________________________
Johns-Manville Sales Corporation

IT IS SO ORDERED:

Original Signed by
Valdas V. Adamkus

By: ______________________________
Regional Administrator, United States
Environmental Protection Agency

Signed: JUN 14 1984, 1984

Entry of this Order is hereby approved:

By: ______________________  Signed: ______________________
United States Bankruptcy
Court

EXHIBIT 1

## I. PLAN FOR ADDITIONAL MONITORING

Specifications for a new air monitoring study are presented in this section. Included are discussions of air sampling, sample analysis, quality assurance procedures, and data interpretation.

### A. Sampling Plan

The purpose of air monitoring is to estimate levels of airborne asbestos at the Johns-Manville site and to compare them with levels at sites which are not influenced by disposal site activities or other sources of asbestos. This requires estimation of both average concentrations and the variability of measured levels at each site. The sections which follow describe considerations for selecting (1) the background site, (2) the number of samples required for various levels of precision in the measurements, (3) the location of monitors at each site, and (4) the sampling times and volumes. The final section describes sampling instrumentation and procedures.

#### 1. Background Site Selection

A desirable location for a background site is one far upwind from the waste disposal site. Given the expected predominance of winds from the east, west, northeast, and southwest (and thus the low probability of northerly winds) due to lake/land effects at the Johns-Manville site,* a location to the south of the plant should be sought for a background site. To assure minimal influence from the waste site, a distance of at least 5 km is recommended. The site itself should be a relatively homogeneous area in terms of land use, and should not be influenced by any other source of asbestos.

Of particular importance is the location of tire stores or automobile shops where brakes are repaired. Since asbestos is frequently used in brake materials, brake repair operations may be a significant source of airborne asbestos.

Sites near gravel or dirt roads should also be avoided for two reasons. First, these sites may be very dusty and, thus, overloading of collection filters may become a problem. Second, some communities have used asbestos-containing crushed stone for road paving. Traffic on these roads may suspend asbestos fibers.

Any data on airborne asbestos from previous air monitoring studies in the Waukegan area should be used in selecting a background site. Low measurements near candidate sites would confirm their suitability.

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* Prevailing annual wind patterns at a local airport are NE-SW. A lake-side location should accentuate this pattern and further minimize northerly winds.

## 2. Number of Samples

The number of samples needed for a desired level of precision in the results depends on the magnitude of the variability associated with all phases of the sampling and analysis process. If several air samples are taken in the same general area but at slightly different locations (e.g., at different points within the waste disposal site) or at different times at the same location, the measurements of sampled material will differ from one another. These differences constitute the sampling component of variability. Sampling variability is due to random fluctuations in the population being sampled, and to factors such as wind speed and direction, atmospheric stability conditions, and the distance from emission sources such as dumping activities or roadways. These latter factors may be viewed as systematic influences on sampling variability, and potentially can be accounted for through sample design.

A second type of variability is that associated with the air sampling instrumentation and chemical analysis procedures. This is called analytic variability and is especially important for asbestos since asbestos fibers are difficult to detect and characterize. This variability can be further subdivided into variability between laboratories and variability within laboratories. Variability between laboratories is due to differences in types of equipment, interpretation of procedures, and analytical practices; variability within laboratories is due to differences between individual analysts (based on differences in experience and training) and differences between repeated readings obtained from the same sample by a single analyst as a result of variability in preparing a sample and in counting fibers.

Due to the sources of variability enumerated above, the measured concentration of asbestos in a single air sample collected at one location for a short period of time is unlikely to be equal to the concentration averaged over the entire site and for a longer time. The degree to which a single estimate departs from the area-wide, long-term value is called the estimation error. This error can be reduced by forming an average of samples taken at more locations, at more times, and by repeated measurement in the laboratory. The magnitude of error will depend both on the number of samples and the total sampling and analytic variability of the measurements.

In order to calculate the number of samples required to achieve a desired estimation error, the amount of expected variability in the measurements must be approximated or assumed. Some data are available from which estimates can be made of variability associated with the analytical method (between and within laboratories), but the spatial and temporal variability of airborne asbestos at the Johns-Manville site is unknown. Therefore, required sample sizes have been calculated assuming a range of possible variabilities, where variability is measured relative to the expected concentration using a term called the coefficient of variation (standard deviation divided by the mean). A large coefficient of variation (e.g., greater than 100%) reflects a high level of variability.

Table 1 shows the relationship between the coefficient of variation, estimation error, and the number of required samples.* For example, if the coefficient of variation for the measurements is 100%, then taking 19 samples will "assure" that the estimation error is ± 60% of the "true" mean.+ In other words, the average concentration for 19 samples should fall somewhere between 60% less than and 60% greater than the "true" mean. Increasing the sample size to 25 reduces the estimation error to ± 50% of the true mean. Once the

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* These calculations are based on several assumptions which may hold only approximately in practice. Therefore the sample sizes should be used only as a guide. See Appendix A for a discussion of the assumptions underlying the calculations.

\+ Although it is not possible to be absolutely sure that the "true" mean will fall within this interval, the probability is high. See Appendix A and footnotes to Table 1. "True" mean simply refers to the area-wide, long-term average.

Table 1. The Relationship Between Sample Size, Coefficient of Total Variation, and Estimation Error

| Coefficient of total variation[a] | Maximum acceptable estimation error as a percentage of the true mean[b] | Required sample size[c] |
|---|---|---|
| 100% | 25% | 78 |
| | 50% | 25 |
| | 60% | 19 |
| | 75% | 14 |
| | 80% | 13 |
| | 100% | 10 |
| 150% | 25% | 160 |
| | 50% | 48 |
| | 60% | 35 |
| | 75% | 25 |
| | 80% | 22 |
| | 100% | 16 |

[a] Standard deviation divided by the mean and expressed as a percentage.

[b] Based on the 95% confidence interval for the true mean calculated from the observed data.

[c] The number of samples required to ensure that the estimation error is less than the specified amount in the second column, with a probability of 90%.

samples have been collected and a sample average calculated, this average becomes the best estimate of the true mean and an actual estimation error is calculated from the sample variance. (This procedure is discussed in Appendix A.)

The two coefficients of variation in Table 1 (100% and 150%) have been selected based on limited data on (1) laboratory variability in measuring asbestos, and (2) temporal variability in particulate matter concentrations at a few sites.* Extrapolating from these data, the coefficient of total variability for airborne asbestos will likely be at least 100% and may be higher than 150%.

A minimum of 25 samples is recommended for the Johns-Manville site. This sample size would provide an estimation error of $\pm$ 50% of the true mean if the coefficient of variation is 100%, or $\pm$ 75% if the coefficient of variation is 150%.

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* Very limited evidence suggests that the coefficient of variation in asbestos measurements due to variability between laboratories may be 50-90% (Steel et al. 1982) and within laboratories, 30-40% (USEPA 1983). Temporal variability in 24-hour measurements of particulate matter at a sample of sites in Illinois (1980 data) produced a coefficient of variation which averaged about 45% (data from USEPA 1981).

For measurements of asbestos levels at background sites, a larger estimation error might be tolerable. For example, it may be sufficient to know only that the background concentration is less than some relatively low level, perhaps 30 $ng/m^3$. If the actual mean is 10 $ng/m^3$, then the maximum tolerable estimation error is $^{-100\%}_{+200\%}$ (or a one-sided error of +200%). A sample size of 5 would be sufficient to "assure" that the estimation error was no larger than this limit. Five samples are thus recommended for the background site.

To illustrate how the size of the estimation error influences interpretation of the monitoring results, suppose the measured mean concentration at the waste site were 200 $ng/m^3$ with an estimation error of $\pm$ 75%, and the mean at this background site were 10 $ng/m^3$ with an error of + 200%. Thus, we could say (with 95% confidence) that the waste site concentration is between 50 and 350 $ng/m^3$ and the background concentration is between 0 and 30 $ng/m^3$. In this example, we can be confident that the two concentrations are clearly different. The smaller the estimation errors, the easier it is to distinguish measured concentrations at the two sites.

3. <u>Monitor Location</u>

Since the air samples collected should be representative of typical concentrations at each site, they must capture both spatial and temporal variations in air levels.

For the waste disposal site, five sampling locations and five sampling times are recommended, thus making a total of 25 separate samples. The sampling locations should be randomly selected within the following constraints: all locations should be at least 30-m from the boundaries of the site (to assure that measurements reflect on-site emissions), and the set of five locations should be approximately symetrical so as to capture high concentration irrespective of wind direction or distance from on-site "sources" (e.g., the disposal pit, roadways, the main landfill). One way to select the sampling locations is to construct a transparent template with a grid superimposed on a circle with five radial sectors (i.e., each sector subscribes $72^{o}$). The template is made about as large as a scale map of the waste site and placed on top of the map. The grid points on the template are numbered and a random number table used to select one location within each sector. Of course, if a selected location falls on water or another physically unsuitable spot, a substitute must be chosen within that sector. This design is intended to make the spatial variability in asbestos concentration random.

For the background site, a single monitor operated for the same five time periods is desirable. A single monitor will suffice since temporal variability is likely to be greater than spatial variability there. The specific location of the monitor will be governed by the usual considerations of security, access, and power availability. Locations near sources of dust should be avoided to prevent overloading of filters with particulate matter.

4. Sampling Times and Volumes

Based on the likelihood of day-to-day variability in on-site activity and meteorological conditions, sampling should be conducted on five separate days. Sampling periods of 12 hours for the waste site and background monitors are suggested. The start and end hours for the 12-hour sampling period should be timed to coincide with the start and end hours of the day work shift at the Johns-Manville plant. These sampling periods should smooth out hourly variability in asbestos levels. Where possible, days with different wind speed and direction should be chosen. In all cases, days with rain or days following precipitation by less than 24 hours should be avoided.

The total volume of air to be sampled is dictated by (1) the lower detection limit of the analytical methodology,* (2) total concentrations of particulate matter at the sites

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* At least 10 asbestos fibers should be counted during EM examination (USEPA 1978).

(and, thus, the potential for overloading filters), and (3) accepted operating practices for sampler flow rates and filter face velocities for airborne asbestos monitoring (Yamate 1982). Based on the findings of the EEI study and on other airborne asbestos monitoring studies (USEPA 1983), a total sample volume of 6,000-11,000 liters is recommended. A volume of 10,800 liters would be collected if the samplers were operated at a flow rate of 15 lpm (12 hrs. at 15 lpm).

Filter "overloading" usually refers to gross clogging of the filter media. In the context of monitoring airborne asbestos, however, it may refer to contamination of the filter with substances other than asbestos fibers. This would require that the filtered material be ashed and refiltered prior to examination by EM. Since ashing and refiltering is not the preferred treatment, a pretest of the sampling plan is recommended to test for contamination.

Ashing and refiltering is also necessary if Millipore rather than Nuclepore filters are used. Millipore filters are sometimes used because they tend to retain fibers better during filter handling and transport. Thus, if the pretest reveals that contamination is a problem and that filter ashing will be necessary, the use of Millipore filters is recommended.

The pretest should consist of three monitors at a single waste site location. (The location should be one likely to produce high asbestos concentrations). The three monitors should be operated with three different flow rates: 5, 10, 15 lpm and the sampling time should be 12 hours. These combinations of flow rates and sampling times will produce high enough sample volumes to assure sufficient quantities of fibers for precise estimates at the highest rate (15 lpm) and low enough filter loadings to reduce contamination by nonasbestos material at the lowest (5 lpm).

After collection, the three pretest samples should be examined by the EM laboratory. Sample preparation should not include ashing and refiltering. If contamination by nonasbestos materials is still substantial at the lowest flow rate in the opinion of the electron microscopists, then the use of Millipore filters and ashing/refiltering procedures will be necessary. Otherwise, the highest of the flow rates which still produces satisfaction fiber identification and measurement should be selected for the monitoring study.

5. <u>Instrumentation and Sampling Specifications</u>

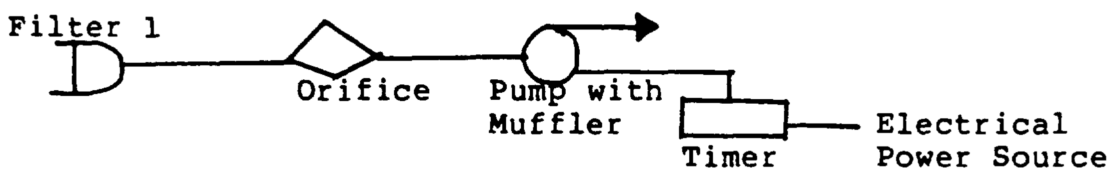
The following sampling procedures are within the class of procedures tested and recommended by EPA (USEPA 1978 and Yamate 1981). More specific information on selected procedures can be found in Appendix B.

a. Sample Setup

The sampling system should consist of:

- A Gelman magnetic-type open-face filter;
- A critical flow orifice;
- A diaphram pump with muffler;
- Associated plumbing and stand; and
- Timer (if desired).

The sampler setup is schematically represented as follows.




b. Specifications

- Flow rate: 5, 10, and 15 lpm for the pretest; one of the three will be selected for the study;

- Filter type: For the pretest and if non-asbestos contamination or fiber loss from the filter is not a problem: 47 mm polycarbonate Nuclepore with a 0.4$\mu$m pore size. At least two 47 mm cellulose acetate (Millipore type HA) filters with 5$\mu$m pore size should be used to support the Nuclepore filter.
  If contamination by nonasbestos particulate matter is a problem: 47 mm cellulose acetate (Millipore type HA) with 0.45$\mu$m pore size.

- Filter height: 1.5 m

c. Sampling Protocol

1. Clean and dry filter holder.

2. Place filter in holder, assuring proper position, see filter handling section below.

3. Mount filter holder such that filter is in a vertical position (perpendicular to ground).

4. Start pump and position filter on holder before replacing holder top to prevent wrinkles.

5. Check plumbing for leaks and check filter holder to assure that it is free of vibration.

6. Check flow with flowmeter using manual control of pump.

7. Set automatic timer to desired on-off time settings (if timer is to be used).

8. Make appropriate logbook entries.

9. Conduct sampling.

10. After sampling period, check flow.

11. Rotate filter to a horizontal position and remove. Secure Nuclepore or Millipore filter in a petri dish with tape for proper handling and transport.

d. Filter Handling

During loading and unloading of the filter holder, the filters should be handled by forceps (not with fingers). When a filter is removed after exposure, it should be placed in the petri holder exposed side up and maintained in that position during the handling and transport of samples back to the laboratory. The samples should be hand-carried to the selected TEM laboratory in a container that will keep the petri dish in a horizontal (flat) position at all times (handling, transport, and storage).

The chain-of-custody system should be followed at all times (see Appendix B). A chain-of-custody record, therefore, will be kept on each filter.

Field blanks should be randomly selected at each site and for each sampling time (see Section I. C. below). Any dropping or mishandling of a filter after collection must be recorded. Each filter holder should be labeled according to a coding system. Laboratory blanks should be selected prior to field sampling (see Section I. C.). If possible, all filters at the same site should be from the same production lot.

e. Meteorological Observations

A wind vane and anemometer should be used to record wind direction and speed at the waste site. Recorded data should then be used to draw a wind rose for each day of sampling.

f. Logbook

An important part of any successful field program is the accurate observations and recordkeeping of the field team. At a minimum, logbook entries should include:

1. Name of field operator;
2. Date of record;
3. Number and location of site;
4. Position of sampler within site;
5. Brief description of site;
6. Corresponding filter number;
7. Sample flow rate at start of sampling period;
8. Start time;

9. Stop time;
10. Sample flow rate at end of sampling period;
11. Wind rose for the sampling period;
12. Description of meteorological conditions; and
13. Comments.

B. Sample Analysis

Air samples should be analyzed by transmission electron microscopy according to the methodology recommended by EPA (USEPA 1978 and Yamate 1981). Two alternative sample preparation protocols are employed. The first is utilized when the sample is collected on polycarbonate Nuclepore filters and, thus, when contamination by nonasbestos materials is not a problem. The second protocol is employed when the sample is collected on Millipore filters (typically cellulose ester or acetate). Which protocol is employed will be determined by the outcome of the pretest, as discussed previously. Brief descriptions of the two protocols are provided below; detailed sample analysis instructions appear in Appendix B.

1. Sample Preparation

a. Samples on Nuclepore Filter

When Nuclepore filters are used, the filter is coated after sampling with a carbon film using a vacuum process. The coated sample is then transferred to an EM grid using a modified Jaffe washer technique. In essence, the Nuclepore filter is placed on top of a carbon-coated EM grid and the filter is dissolved with chloroform. This deposits the carbon-coated sample directly on the grid.

b. Samples on Millipore Filters

Samples on Millipore filters must be ashed and then refiltered on a Nuclepore filter. The filters are first ashed at low temperatures to destroy the filter medium and combustible contaminants. The ashed residue is then re-dispersed by ultra-sonification and filtered with a Nuclepore filter.

2. EM Examination

Fibers are scanned, counted, and sized using an electron microscope at 20,000X magnification. Asbestos fibers are identified using selective area electron diffraction (SAED) analysis.

C. Quality Assurance

To ensure that the information obtained from the air monitoring study is reliable, a quality assurance (QA) program is needed. A formal QA plan has been developed according to the USEPA Office of Toxic Substances (OTS) requirements. This plan establishes organizational responsibilities and specifies procedures for implementing the plan. A complete QA plan is described in Appendix B; only the names of the team members need to be added. The key elements of the QA objectives are briefly described below.

As per OTS specifications, the plan covers, in more detail, the information on sampling and analysis procedures described previously. However, its primary objective is to assure the quality of the data produced.

1. Documentation

Once completed, the QA program provides documentation of all procedures and activities. Such documentation raises the confidence of everyone associated with the study, especially potential users of the study results. Documentation also allows the handling and treatment of individual samples to be traced, if this is needed.

2. Corrective Action

A QA program will provide a mechanism for taking corrective action in response to the identification of data problems. Ideally, corrective action will be taken quickly enough to hold the loss of data to a small fraction of the entire data set.

3. QA Checks

A QA program establishes a series of checks to detect gross problems with data collection, handling, and analysis procedures. These include the analysis of blank samples, multiple analyses of single samples within a laboratory, and multiple analyses by more than one laboratory.

a. Field and Laboratory Blanks

During each sampling period and at each sampling site (i.e., waste disposal and background sites), at least one filter should be randomly selected as a field blank from the filter supply. Thus, a total of 10 field blanks is needed for this study. The blank filter is labelled and handled as any other filter but is not actually used for air sampling. A proportion of the field blanks (at least three) are submitted for analysis along with the test filters. The field blank provides a check for possible filter contamination. If contamination appears to be a possibility, additional field blanks can be analyzed to help determine the extent of the problem.

In a similar manner, at least three blank filters should be exposed on a laboratory bench during preparation and analysis of the samples. At least one of these is then analyzed to check for contamination in the laboratory.

b. Replicate and Duplicate Filter Analysis

As a means of quantifying analytical variability due to preparation and counting procedures, some filters should be selected at random for replicate analysis and some for duplicate analysis. Replicate analyses are done using two independent preparations from the same filter. Duplicate analyses are done by two different analysts using the same TEM grid preparation. It is recommended that a minimum of three filters be selected for each type of analysis and that further analyses be conducted if serious discrepancies appear. For this reason, it is important that all filters and sample preparations are carefully stored.

c. Interlaboratory Quality Assurance

A proportion of the filters (usually about 10% or three for this study) should be analyzed by a second laboratory. These filters are selected at random from the test filters and each is divided in half. One half is analyzed by the main laboratory and the other half by the second laboratory. If serious discrepencies appear, additional filters should be analyzed.

D. Statistical Evaluation

The data will be used to estimate a mean airborne asbestos concentration for the Johns-Manville waste disposal site and for the background site.* For each mean, a 95% confidence interval will be obtained to provide a measure of the estimation error. Comparisons between disposal site and background air levels can be made using standard statistical methods.

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* Averages could also be estimated for subareas within the waste site, but the confidence intervals for these estimates would be very large due to the small number of samples. Data on wind direction and speed will be used to judge the representativeness of the asbestos measurements for each site.

After the data have been colected and an estimate of variance is available, it is possible to evaluate the power of the statistical tests. In the case in which no statistically significant difference is found between two estimated means, the power calculation will provide a measure of how much confidence one can have in that conclusion.

The results from the various QA samples (field blanks, external labosatory, replicate, and duplicate samples) will be compared with the appropriate original analyses. The small number of QA samples precludes formal statistical analysis. However, if inconsistencies or large discrepancies are observed, further QA samples can be analyzed since only a portion of each filter is needed for each analysis.

E. Summary of Sampling and Analysis Design

Table 2 summarizes the key elements of the recommended air monitoring program.

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Table 2. Summary of Key Elements of New Air Monitoring Study

| Site | Number of monitors | Sampling Time | Flow Rates | | Type of Filter | | EM Sample Preparation | |
|---|---|---|---|---|---|---|---|---|
| | | | Pretest | Study | Pretest | Study | Pretest | Study |
| Waste | 5 | 5 days at 12 hrs/day | 5, 10, & 15 lpm[a] | 5, 10, or 15 lpm | Nuclepore | Nuclepore or Millipore[b] | Carbon coating only | Carbon coating only or preceded by ashing & refiltering[c] |
| Background | 1 | 5 days at 12 hrs/day | -- | 5, 10, or 15 lpm[a] | -- | Nuclepore or Millipore[b] | -- | Carbon coating only or preceded by ashing & refiltering[c] |

[a] Depends on results of the pre-test, 15 lpm recommended unless a lower rate eliminates contamination by organic materials.

[b] Use Nuclepore filters if nonasbestos contamination is not a problem (based on results of pre-test); otherwise, use Millipore filters.

[c] Use ashing and refiltering procedures if Millipore filters are used.

## Appendix A. Calculating Sample Sizes

The term "estimation error", as used in Section I. A.2, refers to half of the length of the 95% confidence interval for the true mean. This confidence interval will be calculated from the data after they have been collected and will indicate the magnitude of the error associated with the estimation of the true mean. If the coefficient of total variation is small and/or the sample size is large, then the confidence interval will be short and one will be confident that the true mean is not very different from the value estimated from the data. By "confident" it is meant that 95% of the time the procedure for calculating a 95% confidence interval results in an interval which actually includes the true mean.

The formula for the 95% confidence interval is:

$$\bar{x} \pm t_{(0.025,n-1)} \sqrt{s^2/n}$$

where $\bar{x}$ and $s^2$ are the calcualted sample mean and sample variance, respectively, and $t_{(0.025,n-1)}$ is the upper 2.5 percent point of the t distribution with n-1 degrees of freedom. Note that

$t_{(0.025,n-1)} \sqrt{s^2/n}$ is the estimation error. The aim is to choose the sample size n so that $t_{(0.025,n-1)} \sqrt{s^2/n}$

is not too large. Suppose it is decided that this quantity should be no larger than $d\mu$ where $\mu$ is the true mean and d is a fixed proportion. For example, if the estimation error is required to be no more than 60% of the mean, then d would be made equal to 0.6. Then n has to be chosen so that

$t_{(0.025,n-1)} \sqrt{s^2/n}$ is less than $d\mu$.

It is not possible to be absolutely sure that for a given sample size the resulting confidence interval is sufficiently small, but it is possible to attach a probability to the chance that it will be. For example, it is possible to find n such that the probability that the confidence interval is sufficiently small is 0.9 or 0.95, or any other desired level. If the desired level is $1-\beta$ then it is necessary to find n such that

$$P\left(t_{(0.025,n-1)} \sqrt{s^2/n} \leq d\mu\right) = 1-\beta.$$

This is equivalent to

$$P\left(\frac{(n-1)s^2}{\sigma^2} \leq \frac{(n-1)nd^2\mu^2}{\sigma^2(t_{0.025,n-1})^2}\right) = 1-\beta$$

If it is assumed that the n samples are independent observations from a normal distribution with mean $\mu$ and variance $\sigma^2$ then $(n-1)s^2/\sigma^2$ has a $X^2$ distribution with (n-1) degrees of freedom. The problem is thus reduced to finding n such that

$$\frac{(n-1)nd^2\mu^2}{\sigma^2\ (t_{(0.025,n-1)})^2} = X_{n-1} \quad ,$$

where $X_{n-1}$ is the upper (100%) $\beta$ percentage point of the $X^2_{n-1}$ distribution. Substituting $\sigma^2 = c^2\mu^2$ gives

$$n = \left(1 + \sqrt{1 + 4\ (t_{(0.025,n-1)})^2\ (c/d)^2\ X_{n-1}}\right) /2$$

which can be solved by trial and error.

Table A-1 shows the values of n for different values of the cofficient of variation (c), the size of the 95% confidence interval (estimation error) and different values of the probability of obtaining an error as small or smaller. For example, if the coefficient of variation is 100% and one wants to ensure with probability 0.95 that the estimation error is no greater than ±50% of the true mean, then 27 samples are required. If only 22 samples are collected then the probability is reduced to 0.8.

Table A-1. Sample Size Required to Estimate the Mean with a Desired Level of Precision with the Coefficient of Variation Set at 100% and 150%

| Maximum acceptable estimation error (%)[b] | Probability of achieving acceptable estimation error | | |
|---|---|---|---|
| | 0.8 | 0.9 | 0.95 |
| Coefficient of variation = 100%[a] | | | |
| 25 | 73 | 78 | 81 |
| 50 | 22 | 25 | 27 |
| 60 | 17 | 19 | 20 |
| 75 | 13 | 14 | 15 |
| 80 | 12 | 13 | 14 |
| 100 | 9 | 10 | 11 |
| Coefficient of variation = 150%[a] | | | |
| 25 | 154 | 160 | 176 |
| 50 | 44 | 48 | 50 |
| 60 | 32 | 35 | 38 |
| 75 | 22 | 25 | 27 |
| 80 | 21 | 22 | 24 |
| 100 | 15 | 16 | 17 |

[a]Standard deviation divided by the mean and expressed as percentage

[b]The length of the 95% confidence interval for the true mean calculated from the observed data.

## Appendix B. A Sample Quality Assurance Plan

The organization of this QA Plan conforms to USEPA OTS specifications. The plan includes asbestos sampling and analysis protocols and procedures to assume the quality of the data produced.

# SECTION 1.0

## QUALITY ASSURANCE PLAN

for

## MONITORING AIRBORNE ASBESTOS CONCENTRATIONS AT THE JOHNS-MANVILLE CORPORATION ASBESTOS WASTE SITE, WAUKEGAN, IL.

| | | | |
|---|---|---|---|
| Approved for: | | Approved for: | |
| ______________ | | ______________ | |
| Department Mgr | Date | ______________ | Date |
| QA Administrator | Date | ______________ | Date |

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## 3.0 PROJECT DESCRIPTION

The Johns-Manville Corporation operates an asbestos waste disposal site in Waukegan, Illinois. The EPA Region V Office is conducting an investigation of the site to assess the degree of hazard from airborne asbestos and the need for remedial action. As part of the EPA investigation, measurements of airborne asbestos concentrations at the site will be used to estimate the extent to which concentrations are elevated compared to background levels, and the exposure potential for residents of surrounding areas.

# 4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

## 4.1 Organization

The project organization is given in Figure 1.

## 4.2 Responsibilities

### 4.2.1 Department Management

The individual representing Department Management shall be responsible for overseeing the project and will appoint a Project Manager and QA Administrator.

### 4.2.2 QA Administration

The QA administrator (QAA) shall review the QA plan, ensure that QA requirements are satisfied, and provide documentation to that effect to Department Management.

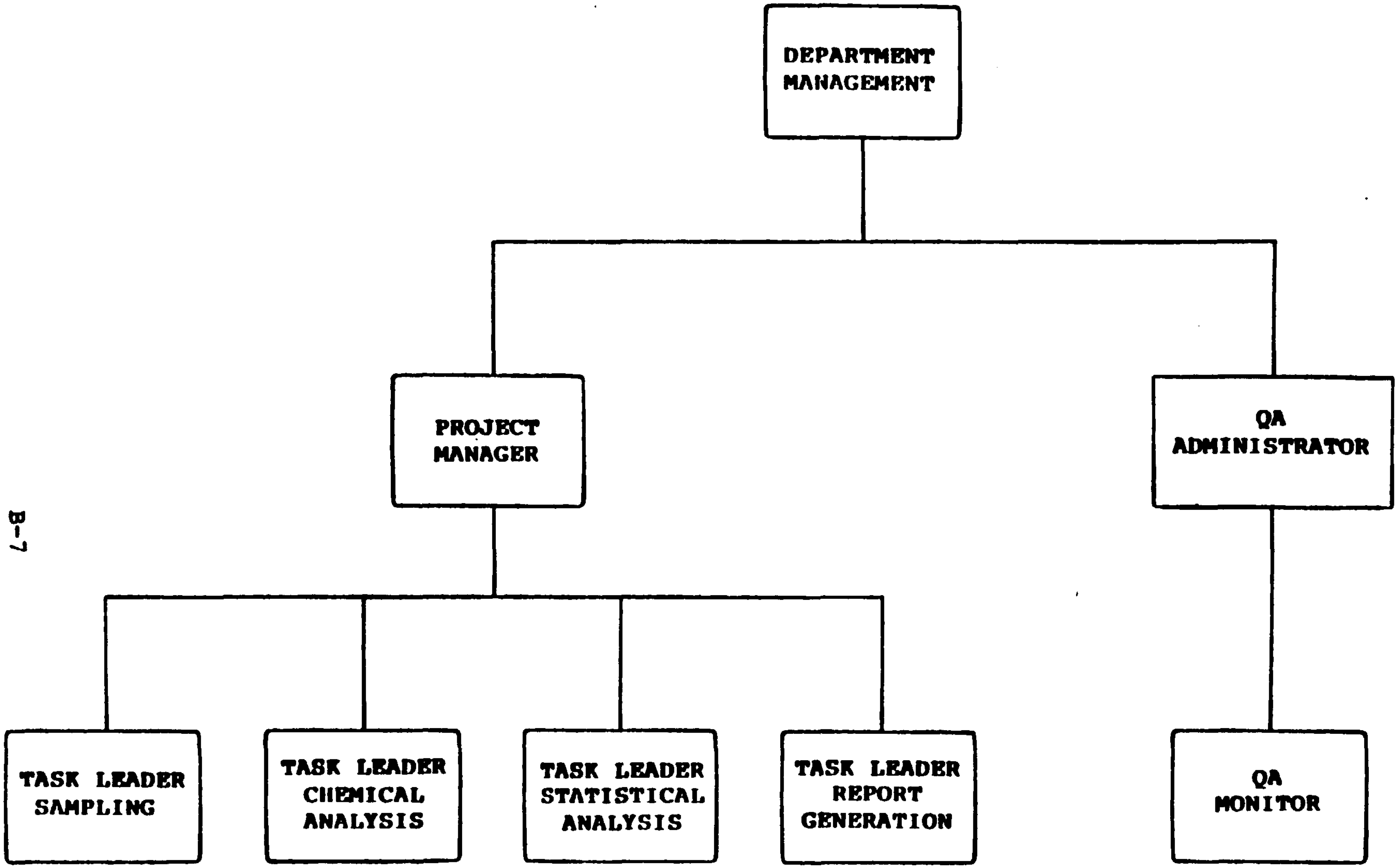


FIGURE 1. PROJECT ORGANIZATION

### 4.2.3 Project Manager

The Project Manager shall be responsible for coordinating sampling, chemical and statistical analyses, and report generation. Task Leaders may be appointed for these various tasks. The Project Manager shall assure that all personnel are fully informed of project QA policy and that any problems, deviations etc. are documented and corrective action is taken.

### 4.2.4 QA Monitor

The QA Monitor (QAM) shall:

- Plan the performance and systems audits.
- Closely monitor the results of the performance and systems audits.
- Communicate closely with the Project Manager.
- Periodically monitor and examine data books, forms, records, or any other hardcopy information.
- Determine and affirm data and sample traceability.
- Inform the Project Manager of any problems and request immediate corrective action.
- Screen data for transcription, calculation, or other errors.
- Provide monthly reports to the QAA.
- Provide documentation to the QAA affirming that the QA requirements of the project have been met.

# 5.0 QUALITY ASSURANCE OBJECTIVES

## 5.1 Accuracy

USEPA believes that transmission electron microscopy is the best available technique for measuring asbestos concentration at the Disposal Area because it provides a means of distinguishing asbestos fibers from nonasbestos fibers and also allows measurement of small as well as large individual fibers. Bundles or clusters of fibers are not included in the calculation of fiber or mass concentration because of the difficulty of assigning meaningful dimensions to these aggregates. Therefore, if bundles or clusters are present transmission electron microscopy (TEM), like any other optical technique, will tend to underestimate the mass concentration.

Subject to availability, National Bureau of Standards (NBS) standard filter preparations of known asbestos concentration will be used to assess the accuracy of the method. Since NBS standards have not been available previously there is little quantitative information on TEM accuracy.

## 5.2 Precision

Fiber counts by TEM can be expected to range from 1 to 1000. Thus, from 1 to 3 significant figures may be reported.

In the duplicate and replicate analyses, coefficients of variation (standard deviation divided by the mean) of the asbestos concentration are expected to be about 0.4 or below unless the concentrations are very low ( 50 $ng/m^3$)[1].

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[1] Constant, P.C. et al, 1983. Midwest Research Institute <u>Airborne Asbestos Levels in Schools</u>. Final Report. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency. Contracts 68-01-5915 and 68-01-5848.

Sample sizes (see Section 6.0) have been selected to ensure that waste disposal site and background levels of asbestos fiber concentration will be estimated with reasonable precision. If the coefficient of total variation (standard deviation divided by the mean) is between 100 and 150% the estimated concentrations are expected[1] to have estimation errors[2] which are no greater than the true means ± 60%.[3]

## 5.3 Representativeness

The sampling plan specifies selection of background site and waste site monitoring locations to ensure representative measurements will be obtained. The background site should not be influenced by the waste site or other sources of asbestos. Air samples shall be taken at five sampling locations and at five sampling times within the waste site to capture both spatial and temporal variations in air levels.

## 5.4 Completeness

The most serious, and most difficult to control, cause of lost samples is human interference and vandalism. Sampling locations shall be chosen to minimize this risk. Loss of samples due to errors by the field sampling crew should not exceed 5 to 10 percent.

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[1] With probability greater than 90%.
[2] The estimation error is defined here as the size of the 95% confidence interval which will be calculated from the observed data.
[3] See Section V.A.2, "Number of Samples," and Appendix A of this report.

## 6.0 EXPERIMENTAL DESIGN

A single location at a background site and five locations at the waste disposal site will be selected. Air samples will be collected simultaneously at all six locations on five separate occasions. This will provide five background samples and 25 waste disposal site samples. This sampling plan is designed to encompass the expected spatial and temporal variability in asbestos concentration.

The sampling locations shall be chosen randomly within the constraints imposed by natural barriers and physical structures and so that any high concentrations of asbestos are likely to be sampled irrespective of wind direction or distance from an on-site 'source' (e.g., the disposal pit, roadways, the main landfill).

To determine the best type of filter, analytical treatment and pump flow rate, a pretest shall be carried out. The pretest will consist of three monitors at a single waste site location that is likely to produce high asbestos concentrations. Polycarbonate Nuclepore filters (0.4$\mu$m pore size) and three flow rates of 5, 10 and 15 lpm will be used for a 12-hour sampling period. The three pretest samples will be examined by an Electron Microscopy (EM) Laboratory with-without ashing or refiltering. If contamination by nonasbestos materials is still substantial at the lowest flow rate in the opinion of the electron microscopists, then the use of cellulose acetate Millipore (0.45$\mu$m pore size) filters and ashing/refiltering procedures will be necessary. Otherwise, the highest of the flow rates which still produces acceptable fiber identification and measurement should be selected for the monitoring study.

A summary of the experimental design is given in Table 1.

TABLE 1. EXPERIMENTAL DESIGN FOR AIR MONITORING STUDY

| Site | Number of monitors | Sampling time | Flow Rates | | Type of Filter | | EM Sample Preparation | |
|---|---|---|---|---|---|---|---|---|
| | | | Pre-test | Study | Pre-test | Study | Pre-Test | Study |
| Waste | 5 | 5 days @ 12 hrs/day | 5, 10, & 15 ℓpm[a] | 5, 10, or 15 ℓpm | Nuclepore | Nuclepore or Millipore[b] | Carbon coating only | Carbon coating only or preceded by ashing & refiltering[c] |
| Background | 1 | 5 days @ 12 hrs/day | -- | 5, 10, or 15 ℓpm[a] | -- | Nuclepore or Millipore[b] | -- | Carbon coating only or preceded by ashing & refiltering[c] |

[a] Depends on results of the pre-test, 15ℓpm recommended unless a lower rate elimates contaimination by organic materials.

[b] Use Nuclepore filters if nonasbestos contamination is not a problem (based on results of pre-test); otherwise, use Millipore filters.

[c] Use ashing and refiltering procedures if Millipore filters are used.

## 7.0 PERSONNEL QUALIFICATIONS

The personnel involved in this study should be experienced in field sampling, chemical and statistical analysis, and the associated QA requirements. The individuals should be identified and their qualifications described as part of the QA plan.

## 8.0 FACILITIES AND EQUIPMENT

The source of equipment for the field sampling should be specified in the QA plan. An EM laboratory with the appropriate microscope factilities shall be selected for analysis of air samples.

## 9.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

The air sampling pump, which is the major sampling equipment item, is a diaphragm type pump which is essentially maintenance-free. Maintenance consists of a check prior to departure. If necessary, diaphragms are changed.

Maintenance records shall be maintained in appropriate notebooks.

## 10.0 CONSUMABLES AND SUPPLIES

The only major consumable items are the filters for the air pumps. If possible, all filters will be selected from the same lot; the numbers of the box and lot from which each filter is taken shall be recorded in the sampling logbook. Laboratory filter blanks will be used to check for contamination of the filter as described in Section 16.0.

## 11.0 DOCUMENTATION

All documentation in logbooks and other documents shall be in ink. If an error is made, it shall be corrected by crossing a line through the error and entering the correct information. Changes shall be dated, initialed, and the reason for the correction stated. The original entry must remain legible.

Details of field sampling, summaries of performance and system audits, sample transfer, results of QA analyses, etc., will be documented in appropriate laboratory notebooks and reports to management as described in the succeeding sections.

## 12.0 DOCUMENT CONTROL

Documents, such as this QA plan, shall be identified by

- Section number
- Revision number
- Date
- Page number

in the top right-hand corner of each page.

The Project Manager shall be responsible for ensuring that data books, notes, records, etc., pertaining to field sampling, results of chemical analyses and computer files used for statistical analyses are properly documented and stored.

The QA monitor, shall keep copies of traceability documents, random number codes applied to samples, summaries of the results of system and performance audits and other materials documenting the implementation of the QA plan.

All documents shall be retained for five years. After five years a decision will be made concerning which, if any, documents shall be retained for a longer period.

## 13.0 CONFIGURATION CONTROL

Air pumps will be placed according to the protocol given in Section 14.1, and regularly checked by the field sampling leader.

## 14.0 SAMPLE COLLECTION

Airborne asbestos sampling will be conducted according to the general procedure outlined elsewhere[1]. This will involve samples taken at both background and waste disposal sites as specified in the sampling plan.

### 14.1 Selection of Sampling Location

Since the air samples collected should be representative of typical concentrations at each site, they must capture both spatial and temporal variations in air levels. For the waste disposal site, five sampling locations and five sampling times shall be collected, thus making a total of 25 separate samples. The sampling locations shall be randomly selected within the following constraints: all locations should be at least 30m from the boundaries of the site (to assure that measurements reflect emissions from "sources" at the site), and the set of five locations should be approximately symetrical so as to capture high concentration irrespective of wind direction or distance from individual "sources" (e.g., the disposal pit, roadways, the main landfill).

For the background site, a single monitor operated for the same five time periods is desirable. A single monitor will suffice since temporal variability is likely to be greater than

1 "Airborne Asbestos Levels in Schools: A Design Study," by B. Price, C. Melton, E. Schmidt, and C. Townley, dated November 20, 1980, a special project report prepared by Battelle's Columbus Laboratories under EPA Contract No. 68-01-3858.

spatial variability there. The specific location of the monitor will be governed by the usual considerations of security, access, and power availability. Locations near sources of dust should be avoided to prevent overloading of filters with particulate matter.

## 14.2 Sampling Times and Volumes

Based on the likelihood of day-to-day variability in on-site activity and meteorological conditions, sampling should be conducted on five separate days. Sampling periods of 12 hours for the waste site monitors and background monitors shall be used. The start and end hours for the 12-hour sampling period should be timed to coincide with the start and end hours of the day work shift at the Johns-Manville plant. These sampling periods should smooth out hourly variability in asbestos levels. Where possible, days with different wind speed and direction should be chosen. In all cases, days with rain or days following precipitation by less than 24 hours should be avoided.

The total volume of air to be sampled is dictated by (1) the lower detection limit of the analytical methodology,[1] (2) total concentrations of particulate matter at the sites (and, thus, the potential for overloading filters), and (3) accepted operating practices for sampler flow rates and filter face velocities for

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[1] At least 10 asbestos fibers should be counted during EM examination. (USEPA 1978. U.S. Environmental Protection Agency. Electron Microscope Measurement of Airborne Asbestos Concentrations, A Provisional Methodology Manual. Research Triangle Park, NC: Office of Research and Development, U.S. Environmental Protection Agency. EPA 600/2-77-178.)

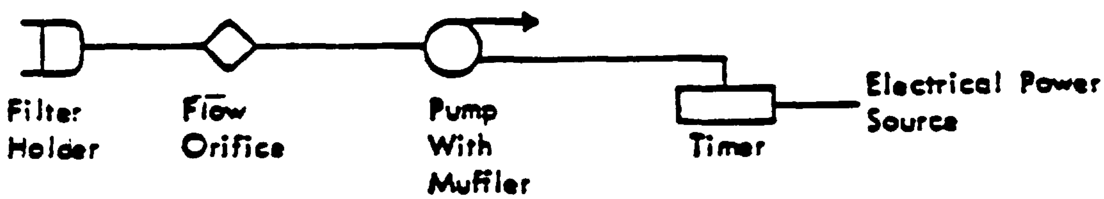
airborne asbestos monitoring[1]. The flow rates shall be selected based on the results of the pretest as described in Section 6.0.

## 14.3 Sampler Setup

The sampling system consists of:

1. An open-face filter holder.
2. A control flow orifice.
3. A pump with muffler.
4. Associated plumbing and stand.
5. A method of measuring sampling time.

The sampler setup is schematically represented as follows.




## 14.4 Sampling Protocol

1. Clean and dry filter holder and place in horizontal position.
2. Place filter in holder, assuring proper position (see filter handling section) and clamp filter in place. For Nuclepore filters at least two 47 mm cellulose acetate (Millipore type HA) filters with 5 $\mu$m pore size should be used as support.

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1 Yamate, G. 1981. Illinois Institute of Technology Research Institute. Methodology for the measurement of airborne asbestos by electron microscopy. Draft Report. Research Triangle Park, NC: U.S. Environmental Protection Agency. Contract 68-02-3266.

3. Rotate filter holder such that filter is in a vertical position (perpendicular to ground).
4. Start pump, check to see that filter is not wrinkled,and put top on filter holder.
5. Check plumbing for any leaks and check filter holder to assure that it is free from vibration.
6. Check flow with flowmeter with the timer control set on manual.
7. Set automatic timer to correct date and time and set on/off trippers to desired on-off time settings.
8. Make appropriate logbook entries.
9. Conduct sampling.
10. After sampling period, check flow, leave pump running.
11. Rotate filter to horizontal position, stop pump and remove filter. Attach Millipore or Nuclepore filter to a petri dish with tape and cover with lid for proper handling and transport. Number petri dish.

## 14.5 Filter Handling Procedures

1. Handle the filters by forceps (not with fingers) during loading and unloading of the filter holders.
2. After sampling, place the exposed filter in the petri holder (Millipore filters) exposed side up and maintain in that position during the handling and transport of the samples to the laboratory.

3. Hand-carry the samples in a container to the laboratories doing the chemical analyses.
4. Handle the container in a way that will keep the petri holders and the Nuclepore filter cassettes in a horizontal (flat) position at all times (handling, transport, and storage).

## 14.6 Laboratory Blanks

Use filters from the same production lot number, if possible. Prior to field sampling, select six filters (at least one per box) to serve as laboratory blanks and keep in laboratory until analysis. These blanks are used to check that the fibers are not contaminated prior to,or after sampling.

## 14.7 Field Blanks

During each of the five sampling periods, randomly select one field blank (filter) from a new box of filters at each sampling site (i.e., waste disposal and background sites). This will results in a total of 10 field blanks. Encode and handle the blank filters according to the same protocol as the test filters.

## 14.8 Log-Book Entries

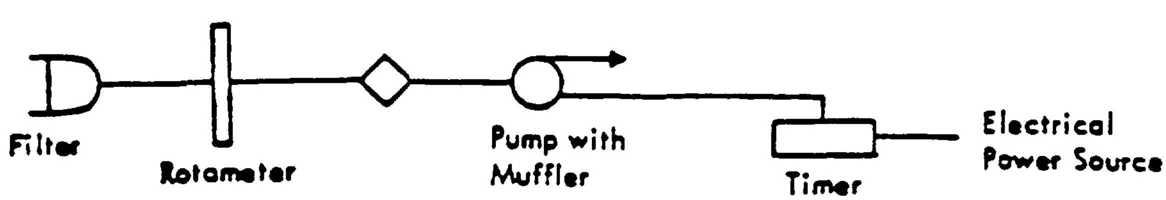
An important part of any field program are the observations and accurate records of the field team. As a minimum, logbook entries shall include:

1. Name of field operator.
2. Date of record.
3. Number and location of site.
4. Position of sampler within site.
5. Brief site description (sketch).
6. Filter number.
7. Identification numbers of pump, timer and filter holder.
8. Sample flow rate at start of sampling period.
9. Start time.
10. Stop time.
11. Sample flow rate at end of sampling period.
12. Wind rose for the sampling period.
13. Description of meteorological conditions.
14. Comments.

## 14.9 Procedure for Measuring Flow in the Field

This procedure describes the process used to determine the sample flow rates through the filters used to collect asbestos fibers in ambient air:

1. Set up the sampling system as shown below with the rotameter positioned as shown below.



2. Turn on the pump and with the filter in place, record the rotameter reading in the notebook.
3. Turn off the pump and remove the rotameter from the sampler.
4. Reconnect all tubing.
5. The sampler is ready to operate.
6. Repeat procedures 1 through 3 at the end of the sampling period.
7. Calculate the flow as follows:
   a. Using the calibration curve for the rotameter, determine the flow rates for each rotameter reading and record these values on the data sheet.
   b. Calculate the average flow rate for the sampling period using the following equation:

$$\text{average flow rate} = \frac{(\text{initial flow rate} + \text{final flow rate})}{2}.$$

   c. Calculate the actual volume of sample collected by multiplying the average sample rate by the sampling time.

## 15.0 SAMPLE CUSTODY

Sample traceability procedures described herein will be used to ensure sample integrity.

1. Each sample (filter) shall be issued a unique project identification number as it is removed from the pump. This number shall be recorded in a logbook along with the following information:
   a. Name and signature of field operator.
   b. Lot or assigned batch number (or any other identifiable number).
   c. Filter type (e.g., Millipore, Nuclepore).
   d. Date of record.
   e. Site (background or waste-disposal).
   f. Location of sampler within site.
   g. Use of filter, i.e., field blank, lab blank or test filter.
   h. Condition of sample.
   i. Sample flow rate at start of sampling period.
   j. Start time.
   k. Stop time.
   l. Sample flow rate at end of sampling period.
   m. Any specific instructions/comments.
2. A traceability packing slip shall be filled out in the field.

3. The samples shall be hand-carried to the laboratory responsible for chemical analysis where the package contents shall be inventoried against the traceability packing slip.
4. A copy of the inventory sheets shall be sent to the QA monitor. The original will remain in the field sampling leader's project files. A set of random numbers shall be generated and assigned sequentially to each sample replacing the field identification numbers. The relationship between the two sets of numbers shall be recorded and a copy retained by the QAM. Warning labels (if appropriate) will be affixed.
5. In order to maintain traceability, all transfer of samples (e.g., to other laboratories for QA analysis) shall be recorded in an appropriate notebook. The following information shall be recorded:
   a. The name of the person accepting the transfer, date of transfer, location of storage site, and reason for transfer.
   b. The assigned sample code number, which remains the same regardless of the number of transfers.

After the samples are properly logged in they will be placed in suitable storage areas. These areas will be identified as to the hazard they present to the samples.

## 16.0 SAMPLE ANALYSIS PROCEDURES

All air samples shall be hand-carried to the laboratory carrying out the chemical analysis and shall be kept encoded during microscopy analyses. They shall be decoded by the QA monitor after all analyses are completed.

Upon receipt of filters the laboratory shall record in a laboratory logbook the sample numbers, date they were received, and any macroscopic identifying characteristcs of particular filter samples. This includes damaged or smudged areas on the filter surface, lack of uniform sample deposition, unattached particulate or debris, unusually heavy-appearing deposit concentration, or other evidence of unusual condition.

Any damaged areas removed prior to sample preparation shall be mounted on glass slides using double-sided adhesive and the diameter of the effective filter area shall be measured. The total effective filter area and damaged areas of sample removed should be accurately recorded for subsequent calculation of asbestos concentrations.

Analysis shall be by transmission electron microscopy according to the methodology recommended by EPA [1,2].

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[1]USEPA. 1978. U.S. Environmental Protection Agency. Electron Microscope Measurement of Airborne Asbestos Concentrations, A Provisional Methodology Manual. Research Triangle Park, NC: Office of Research and Development, U.S. Environmental Protection Agency. EPA-600/2-77-178.

[2]Yamate, G. 1981. Illinois Institute of Technology Research Institute. Methodology for the measurement of airborne asbestos by electron microscopy. Draft Report. Research Triangle Park, NC: U.S. Environmental Protection Agency. Contract 68-02-3226

Two alternative sample preparation protocols are employed. The first is utilized when contamination by nonasbestos materials is not a problem and the sample is collected on polycarbonate Nuclepore filters. The second protocol is employed when the sample is collected on Millipore filters (cellulose acetate). Which protocol is employed will be determined by the outcome of the pretest, as discussed in Section 6.0. Both protocols are described below.

## 16.1 Sample Preparation

### 16.1.1 Samples on Millipore Filters

In the original sample dish, cut a 90 radial section of the original 47-mm filter sample with a clean, single-edged razor blade. Transfer the quarter section with stainless steel forceps to a clean 1 in. x 3 in. glass slide, and cut again into smaller wedges to fit into the glass ashing tube (approximately 15-mm long). Transfer the wedges by forceps to clean, numbered ashing tube. Place the tube in an LFE 504 low temperature plasma oven, one sample tube and one laboratory control tube per ashing chamber. The laboratory control tube may either contain a blank Millipore filter or be run as an empty tube. Maintain the ashing process at 450 watts for 2 hr.

Upon removal from the oven, treat the ashing tubes as follows. Place the tube in an ultrasonification bath. Pour 1 to 2 ml of 0.22 $\mu$m filtered Millipore-Q water into the tube from a clean 100 ml graduated cylinder. Sonicate (at 40 milliamperes) the sample vigorously for approximately 5 min and transfer it to a clean 150 ml glass beaker. Rinse the tube by additional ultra-sonification two or three times more using a few milliters of filtered water each time, and transfer the contents to a 150 ml sample beaker. Add the remaining volume (up to 100 ml) of filtered water and sonicate again the entire suspended sample or blank, so that the total time of dispersion in the sonicator takes at least 20 min. Use a clean glass rod to stir the suspended sample while it is being sonicated.

Divide the 100 ml fraction into three aliquots: 10, 20, and 70 ml, prepared in that order. Using a 25-mm Millipore filter apparatus, place a 0.1 $\mu$m Nuclepore polycarbonate filter on top of an 8.0 $\mu$m mixed cellulose ester Millipore backup filter. Wet the filters by aspirating approximately 10 ml of filtered deionized water. Stop aspiration, pour in the first sample aliquot or portion thereof, and begin the aspiration procedure again. Carefully add the remaining sample volume without disturbing the flow across the Nuclepore filter surface. The suspended sample may be resonicated or stirred between filtration of the aliquots.

When the sample is deposited, carefully transfer the Nuclepore filter to a clean, labeled (sample number, date, and aliquot size) 1 x 3 in glass slide. Discard the Millipore backup filter.

When dry, attach the 0.1 $\mu$m Nuclepore filter tautly to the slide with transparent tape. Coat the filter with an approximately 40-nm-thick carbon film (national Spectroscopic Laboratories carbon rods) by vacuum evaporation. The film thickness need be sufficient only to provide support for the deposit sample.

Transfer the polycarbonate filter deposit to a 200-mesh electron microscope copper grid (E. G. Fullam) by first cutting a 3-mm-square portion from the filter using a clean, single-edged razor blade. Place this deposit side down on the electron microscope (EM) grid which, in turn, has been set upon a small, correspondingly labeled portion of lens tissue paper. Place the film, grid, and lens paper on a Jaffe dish consisting of a copper screen supported on a bent glass rod in a covered 90-mm glass petri dish. Pour reagent grade chloroform (J.T. Baker Company) into the dish to saturate the lens paper without submersing the grid and sample. Keep the dish covered at room temperature for 2 hr. Shift the prepared sample to a clean petri dish with fresh chloroform. Heat to 40°C for 10 min to provide a washing procdure.

While it is still wet, place the sample grid in a small gelatin capsule. Tape the capsule to the slide that has the remaining coated polycarbonate filter, and store until analysis.

### 16.1.2 Samples on Nuclepore Filters

The above ashing and refiltering procedures are unnecessary for samples collected directly on Nuclepore filters. Instead, the filter is carbon-coated and transferred to an EM grid as described in the preceding three paragraphs.

## 16.2 Microscopic Procedure

Select a sample or, for samples ashed and refiltered, start with the 70-ml aliquot of filtered material. Examine the EM grid under low magnification in the transmission electron microscope to determine its suitability for examination under high magnification. Ascertain that the loading is suitable and is uniform, that a high number of grid openings have their carbon film intact, and that the sample is not contaminated excessively with extraneous debris or bacteria.

Scan the EM grid at a screen magnification of 20,000X. Record the length and breadth of all fibers that have an aspect ratio of greater than 3:1 and have substantially parallel sides. Observe the morphology of each fiber through the 10X binoculars and note whether a tubular structure characteristic of chrysotile asbestos is present. Switch into selective area electron diffraction (SAED) mode and observe the diffraction pattern. Note whether the pattern is typical of chrysotile or amphibole, ambiguous, or neither chrysotile nor amphibole. Use energy dispersive X-ray analysis where necessary to further characterize the fiber. Take pictures as desired representing the sample type, fiber/particulate distribution, or characteristic SAED patterns of chrysotile and specific amphibole types.

Count the fibers in the grid openings until at least 100 fibers, or the fibers in a minimum of 10 grid openings, have been counted. Once counting of fibers in a grid opening has started, the count shall be continued though the total count of fibers may be greater than 100.

To ensure uniformity of grid opening dimensions, examine several 200-mesh grids by optical microscopy and measure roughly 100 opening per grid. Average these dimensions to provide a standard grid opening area.

## 16.3 Calculations

Calculate from the following equation, fiber number concentration expressed as the total number of fibers/volume of air:

$$\text{Fiber counts } (f/m^3) = (\text{number of fibers counted})\ (\text{area factor*}) \left(\frac{\text{dilution factors**}}{\text{volume sampled, } m^3}\right)$$

Calculate fiber mass for each type of asbestos in the sample by assuming that the breadth measurement is a diameter; thus, the mass can be calculated from:

$$\text{Mass } (\mu g) = \frac{\pi}{4} \cdot (\text{length, } \mu m) \cdot (\text{diameter, } m)^2 \cdot (\text{density, } g/cm^3) \cdot 10^{-6}$$

The density of chrysotile is assumed to be 2.6 $g/cm^3$, and of amphibole, 3.0 $g/cm^3$. The mass concentration for each type of asbestos is then calculated from:

$$\begin{array}{c}\text{Mass Concentration} \\ (\mu g/m^3) \text{ of a} \\ \text{Particular Type}\end{array} = \frac{\left(\begin{array}{c}\text{Total Mass of All} \\ \text{Fibers of that Type (ug)}\end{array}\right) (\text{area factor*})\ (\text{dilution factors**})}{\text{Volume of Air Sampled } (m^3)}$$

---

$$\text{*Area factor} = \frac{(\text{total effective filter area, } cm^2)}{(\text{number of grids examined})\ (\text{average area of an EM grid opening, } cm^2)}$$

**Dilution factors take into account sample dilution during ashing and refiltering and transfer to the EM grid. The factor = 1.0 for samples collected on Nuclepore filters. For the samples collected on Millipore filters, the factor = $[(\text{proportion of original filter ashed})\ (\text{aliquot volume}, cm^3/100\ cm^3)]^{-1}$

Record the fiber bundles and clusters as such, but do not include them in the mass calculation or the fiber count. The fiber clusters and fiber bundles are not included in the mass calculation because (1) it is difficult to assign the third dimension to the two-dimensional observation of the aggregates, (2) it is difficult to determine void space within bundles and clusters, and (3) since the bundles and clusters make up only about 2% of the item count, one cannot be certain of the even distribution throughout the filter.

### 16.4 Field Blanks

From the 10 field blanks, three shall be randomly selected by the QA monitor for chemical analysis to check for contamination. These three filters shall consist of one filter from the background site, and two from the waste-disposal site. The remaining 7 field blanks shall be kept for additional analyses, if necessary. If field blank contamination is detected, it may be appropriate to analyze one or more factory blanks to check whether the filters were contaminated prior to being taken into the field.

### 16.5 External Quality Assurance Filter Analysis

As a quality assurance measure, the QA monitor shall randomly select three samples to be analyzed by an external certified laboratory (QA laboratory). All filters selected for QA analysis shall be divided in half according to the analytical protocol for air samples and one half of each filter shall be hand-carried to the QA Laboratory. In addition, three laboratory blanks will be sent to the QA Laboratory and at least one of these will be analyzed by the QA Laboratory (see Section 16.7). The results from the QA laboratory will be compared with those from the primary laboratory. If serious discrepancies appear, additional filters should be analyzed.

## 16.6 Replicate and Duplicate Filter Analyses

As a means of quantifying in-house variability, and analytical variability introduced by the filter preparation procedure, samples shall be selected by the QA monitor for replicate and duplicate analyses. Replicate analysis shall be performed using two independent preparations from the same filter. Duplicate analyses shall be conducted by a second analyst using the same grid preparation as in the original analysis. For this purpose, filters shall be randomly selected from the remaining filters (i.e., those not chosen for external QA analysis). Three filters shall be selected for duplicate analyses and three for replicate analyses.

## 16.7 Laboratory Blanks

As a means of checking on possible contamination during the preparation procedures, at least three laboratory blank filters should be subjected to standard laboratory procedures during preparation and analysis of the samples. At least one of these is then analyzed to check for contamination in the laboratory. This procedure should be followed at both the main laboratory and at the external QA laboratory.

Table 2. Number and Types of Chemical Analyses

| | | Field blank | | Test filters | | |
|---|---|---|---|---|---|---|
| | Laboratory blanks | Background | Waste-Disposal | Background | Waste-Disposal | Total |
| Filters available for analysis | 6 | 5 | 5 | 5 | 25 | 30 |
| Filters actually analyzed | 2[a] | 1 | 2 | 5 | 25 | 30 |
| Filters for external QA | See above | | | | | 3 |
| Filters for replicate analysis | | | | | | 3 |
| Filters for duplicate analysis | | | | | | 3 |
| Total number of chemical analysis | 2 | 1 | 2 | | | 39 |

[a] One by main laboratory and one by external QA laboratory.

## 17.0 ROTAMETER CALIBRATION PROCEDURES AND REFERENCE MATERIALS

### 17.1 Rotameter Calibration Procedure

1. Record the preliminary data at the top of the data sheet shown in Figure 2.
2. Set-up the calibration system as shown in Figure 3. Allow wet test meter to run for 20 min. before starting the calibration.
3. Turn on the pump and adjust the flow until the pyrex ball is around 25 on the rotameter scale.
4. Record both the SS and pyrex ball values on the data sheet.
5. Measure the volume of air which passes through the rotameter during an accurately timed interval. Record the initial and final times and wet test meter readings.
6. Record the wet test meter temperature (Tw) and manometer readings ($\Delta P$) during the time interval.
7. Run at least duplicates for each rotameter setting.
8. Reset the pyrex ball to around 90 and repeat Steps 4 through 7.
9. Reset the pyrex ball to around 120 and repeat Steps 4 through 7.
10. Calculate flow rates for each setting using the equation:

$$Q = \frac{(V_w \times Corr)}{Time} \left[ \frac{(P_b - V_p) + \frac{\Delta p}{13.6}}{P_s} \right] \left[ \frac{T_s}{T_w + 273} \right]$$

Flowmeter type ______________________ Tube ______________

I.D. no. ______________________ Date ______________

Barometric pressure, Pb ______________ "$H_2O$ Initial ______________

Standard pressure, Ps ______________ "$H_2O$ Standard temp, Ts ______ ° K

| Test no. | Flowmeter ball, mm | | Wet test meter (corr. = ) | | | | | $Q^b$ Flowrate Std cc/min |
|---|---|---|---|---|---|---|---|---|
| | SS | Pyrex | Time min | Vw cc | ΔP "$H_2O$ | Tw °C | $Vp^a$ "Hg | |
| | | | | | | | | |

[a] From vapor pressure vs. temperature tables

$$^{b}Q = \frac{(Vw \times Corr.)}{Time}\left[\frac{(Pb - Vp) + \left(\frac{\Delta P}{13.6}\right)}{Ps}\right]\left(\frac{Ts}{Tw + 273}\right)$$

FIGURE 2. FLOWMETER CALIBRATION DATAFORM, > 1000 cc/min

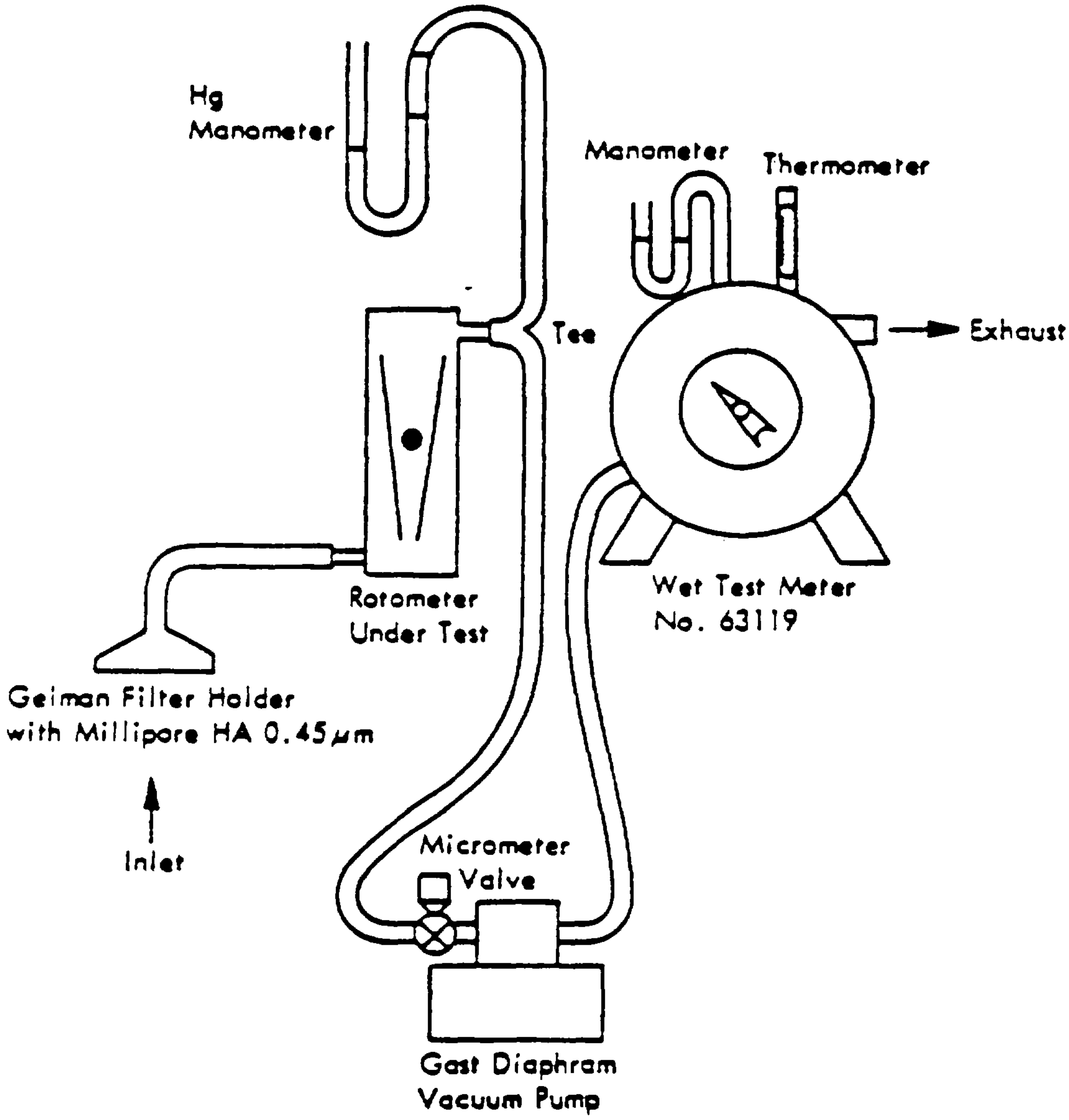



FIGURE 3. ROTAMETER CALIBRATION SYSTEM

where:

| | |
|---|---|
| Q | = flow rate in standard cc/min, |
| $V_w$ | = wet test meter volume in cc, |
| Corr. | =correction value obtained for each specific we test meter, |
| Time | =time in minutes, |
| $P_b$ | =barometric pressure in inches of $H_2O$, |
| $V_p$ | =vapor pressure in inches of $H_g$, |
| $\Delta p$ | =manometer reading in inches of $H_2O$, |
| $P_s$ | =standard pressure in inches of $H_2O$, |
| $T_s$ | =standard temperature in $^oK$, and |
| $T_w$ | =wet test meter temperature in $^oC$. |

10. Plot rotometer readings versus values of Q for each setting as shown in Figure 4.

## 17.2 Rotameter Calibration Schedule

Rotameters shall be checked, cleaned if necessry, then calibrated prior to the first sampling trip.

## 17.3 Reference Materials

Standard materials of known asbestos type shall be used as references for fiber morphology and electron diffraction patterns.

Subject to availability, National Bureau of Standards standard filter preparations of known asbestos concentration will be used to assess the accuracy of the TEM method.

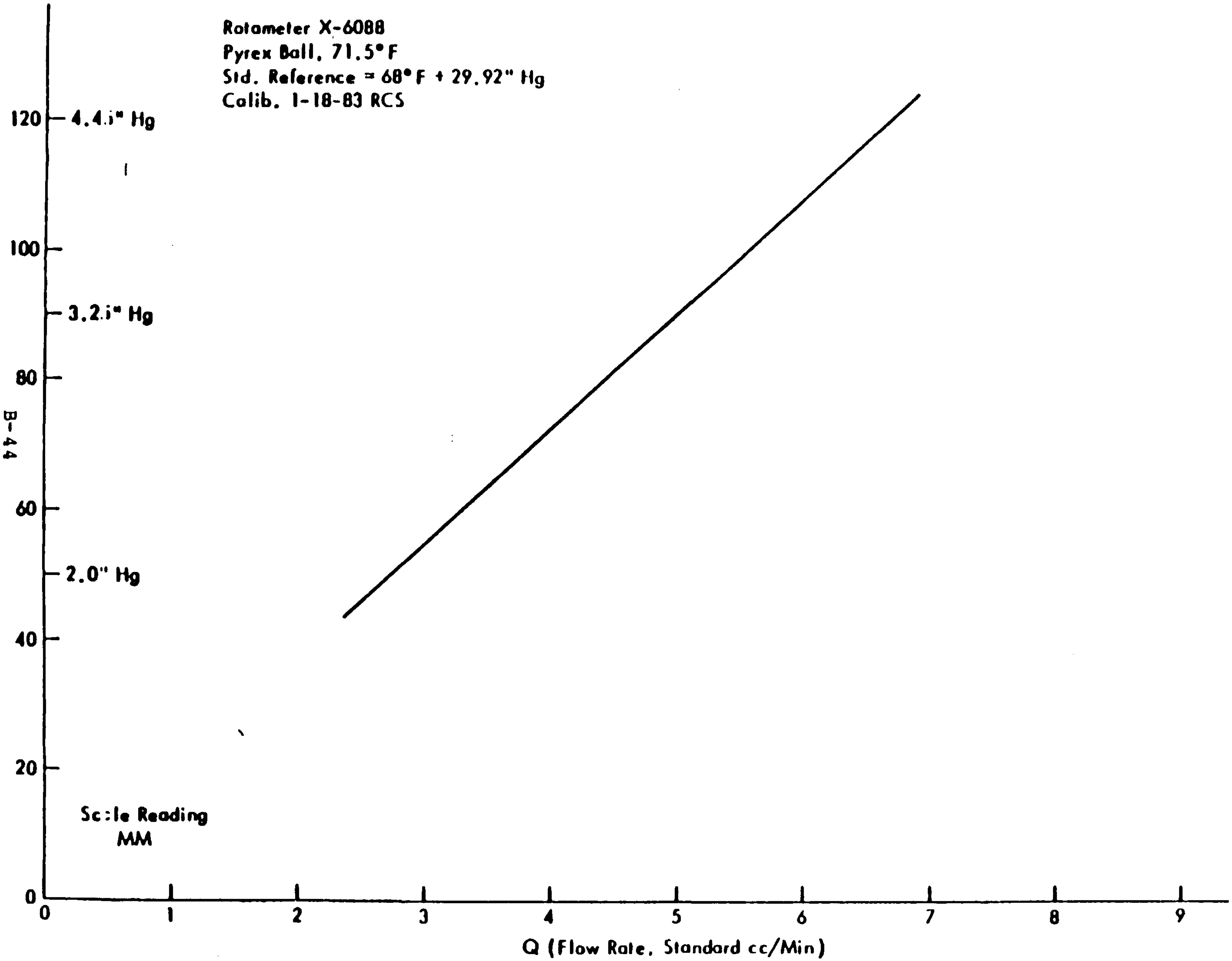



FIGURE 4. PLOT OF ROTAMETER READINGS VERSUS VALUES OF Q

## 18.0 DATA VALIDATION

As a minimum, the guidelines listed below should be followed:

- When calculations are made by hand, 2 people shall spot check some calculations independently and then compare results; correct, if necessary.
- When computer is used, data entry shall be verified; programs, formulae, etc..., shall be tested with sample data previously worked out by hand.
- When statistical software packages are used, tests of reason shall be applied; on outputs, double-check sample sizes, degrees of freedom, variable codes, etc...; be alert for outliers.
- When reporting numerical results, computer generated outputs rather than retyped tables shall be used to the extent possible. When possible, reported tables shall be compared for consistency in variable codes and values, sample sizes, etc...

In all cases, data validation activities shall be documented and records kept of any necessary corrective action in the appropriate notebook.

## 19.0 DATA PROCESSING AND ANALYSIS

Standard statistical techniques will be used to estimate mean airborne asbestos concentration for the waste disposal site and for the background site. A 95% confidence interval will be obtained to provide a measure of the error involved in the estimation. Comparisons between the disposal site and background concentrations will be made.

Power calculations shall be made to indicate the power of the statistical tests to detect differences between means.

The results from the various QA analyses (field blanks, external laboratory, replicate and duplicate analyses) will be compared with the appropriate original analyses. The small number of QA samples precludes formal statistical analysis. However, if inconsistencies or large discrepancies are observed, further QA samples can be analyzed since only a portion of each filter is needed for each analysis.

## 20.0 INTERNAL QUALITY CONTROL CHECKS

Internal quality control is achieved by the use of

- laboratory blanks (filters)
- field blanks (filters)
- external laboratory QA analyses
- replicate analyses
- duplicate analyses
- data entry checks
- data transfer checks

as described in Sections 14, 16 and 18.

## 21.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits provide the primary means for external monitoring for this project. These audits will be performed during the field sampling by an individual appointed by the QA monitor.

### 21.1 Performance Audits

| Device to be Audited | Audit Device |
|---|---|
| Diaphragm pump | Calibrated rotameter |

* Performance Audit Procedure

- Verify calibration of the rotameter against standard reference device.
- Review EPA standard methods and/or other test protocols.
- Directly measure flow rate against rotameter.
- Record all data on performance audit form. In general, all reported values should be within ± 10% as compared to the audit device.
- Prepare and submit a summary report, and all records to the QA monitor.

## 21.2 System Audit

| Area to be Audited | Audit Mechanism |
|---|---|
| Entire Sampling Procedure | Standard Audit Form |

* System Audit Procedure

- Review test procedures and protocols.
- Obtain standard audit form.
- Observe the performance of each task.
- Ask questions as required.
- Take corrective actions as necessary.
- Fill in appropriate blank lines on audit form.
- Prepare and submit summary report, and all records to QA monitor.

## 22.0 DATA ASSESSMENT PROCEDURES

Precision of the data will be determined by performing replicate analyses or replicate sample preparation and analyses operations. The measurement for precision will be the coefficient of variation (standard deviation/mean). Tests for outliers will be performed on data obtained from the primary laboratory. Data from both the primary and external QA laboratories will be compared and checked for discrepancies.

## 23.0 FEEDBACK AND CORRECTIVE ACTION

The types of corrective action procedures which will be used for this program are:

- On-the-spot, immediate, corrective action.
- Closed-loop, long-term, corrective action.

### 23.1 On-the-Spot Corrective Action

This type of corrective action is usually applied to spontaneous, non recurring problems, such as an instrument malfunction. The individual who detects or suspects non-conformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., immediately notifies his/her supervisor. The supervisor and the appropriate task leader then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the task leader must prepare a memo to the Project Manager and the Quality Assurance Monitor. These individuals will collectively decide how to proceed. If the problem is limited in scope, then the task leader decides on the corrective action measure, documents the solution in the appropriate workbook and notifies the Project Manager, and the QA monitor in memo form.

## 23.2 Closed-Loop, Long-Term Corrective Action

Long-term, corrective action procedures are devised and implemented in order to prevent the re-occurrence of a potentially serious problem. The QAM is notified of the problem and conducts an investigation of the problem to determine its severity and extent. The QAM then files a corrective action request with the appropriate Task Leader, with a copy to the Project Manager, requesting that corrective measures be put into place. Suggestions as to the appropriate corrective action will also be made. The Task Leader is responsible for implementing any corrective actions. The QAM will conduct a follow-up investigation to determine the effectiveness of the corrective action.

## 24.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

In general, monthly summary reports to management shall include information from:

- Inspections, performance audits and/or systems audits.
- Reports and/or findings of irregularities or non-conformance to program quality policies.
- Status of solutions to any problem area.

Procedurally, the QA Monitor will prepare the reports to management. These reports will be addressed to the Project Manager and the QA administrator. The summary of findings shall be factual, concise and complete. Any required supporting information will be appended to the report.

## 25.0 REPORT DESIGN

The project report will contain the following sections:

(1) Executive Summary

(2) Overview of the Experimental Design

Background

Purpose and Objectives

Experimental Design

(3) Description of the Results

(4) Conclusions and

(5) Methodological Report

Experimental Design

Sampling Procedures

Chemical Analysis

Statistical Analysis

Data and Data File Documentation

This QA plan will be included as appendix together with documentation of any deviations from the plan. Results of analyses of external QA, replicate and duplicate analyses will be presented and discussed.

*Exhibit 2*

SPECIFICATIONS

FOR

GEOTECHNICAL AND HYDROLOGICAL INVESTIGATION

OF THE

WASTE DISPOSAL SITE STUDY

AT

JOHNS-MANVILLE SALES CORPORATION
WAUKEGAN, ILLINOIS PLANT

PROJECT: S94-3224

Prepared by: Manville Service Corporation
P. O. Box 5108
Denver, CO 80217

June 1, 1984
Submitted to Illinois EPA and USEPA

0610W

# GEOTECHNICAL AND HYDROLOGICAL INVESTIGATION SPECIFICATIONS

Waukegan - Waste Disposal Site Study
Project S94-3224

## 1.0 Scope of Work

1.1 The field work area for this investigation shall be confined to the Johns-Manville Sales Corporation, Waukegan, Illinois plant property as shown on contract drawings listed below.

Contract Drawings

| Dwg. No. | Title | Remarks |
|---|---|---|
| A36121-4 | Proposed Groundwater Monitoring Well Locations | |
| A36122-4 | Proposed Soil Sampling Locations | |
| A42000-1 | Topographic Map Waste Disposal Site Study | The Sidewell Co. dwg Job No. T2-020 |

1.2 The geotechnical and hydrological investigation shall consist of the following phases:

1.2.1 Work Plan Preparation.

This phase should include the following items:

1.2.1.1 Site Health and Safety Plan.

1.2.1.2 Quality Assurance Project Plan.

1.2.1.3 Field Protocols.

1.2.1.4 Subcontractor Procurement.

1.2.1.5 Site Safety and Decontamination Facilities.

The initial site visit portion normally associated with this phase will be completed during bidding phase prior to issuance of contract.

See paragraphs 1.3 and 1.4 for submittal requirements.

1.2.2 Soil Sampling and Analysis.

1.2.3 Groundwater Monitoring Well Installation.

1.2.4 Groundwater Quality Sampling and Analysis.

1.2.5 Preparation and Submittal of Technical Report.

The report shall include the technical memorandums for the soil and water sampling and analysis.

1.3 Within thirty (30) days from award of contract and prior to the initiation of any site work, the Consultant shall submit to the Owner, Illinois EPA, and USEPA for approval of the following documents and/or plans:

1.3.1 Site Health and Safety Plan.

1.3.2 Quality Assurance Project Plan.

1.3.3 Field Protocols.

1.3.4 Site Safety and Decontamination Facilities.

1.4 Prior to the initiation of any site work, the Consultant shall submit to the Owner only for approval of the following documents and/or plans:

1.4.1 Subcontractor Procurement.

2.0 <u>Work Not Included</u>

2.1 Site Data

The collection and cataloging of existing site data to develop a bibliography of the existing disposal site. The necessary information for this function will be provided by the Owner.

2.2 Topographic Survey

A recent topographic map will be provided by the Owner. See contract drawing list.

2.3 Warning Sign Installation

The installation of warning signs will be completed under separate contract issued by the Johns-Manville Waukegan Plant.

## 3.0 Site Health and Safety Plan

Prior to the initiation of any on-site drilling, several items shall be provided and/or procedures established by the Consultant. The work under this section shall consist of the following:

3.1 Documentation of Field Data and Laboratory Work.

Standard forms shall be required for boring logs, chain of custody records, field and laboratory notebooks, sample labels, etc.

3.2 Site Safety

Site safety program shall be developed in accordance with approved operating procedures. These procedures shall be distributed to all field personnel including subcontractors. Standard safety practices for drilling shall be adhered to including periodic checking of equipment.

3.3 Emergency Procedures

A person shall be required on-site at all times that is trained in emergency first aid. Arrangements shall be made in advance for emergency medical treatment, posting telephone numbers for emergency and ambulance services, and name, directions, telephone number of nearest medical facilities.

3.4 Personnel Protective Equipment

See Site Safety Decontamination Facilities, paragraph 7.0, page 5 of the specifications.

3.5 Weather

Under extreme weather conditions, an assessment shall be made for the necessity of additional protection and/or monitoring of personnel (e.g., for heat stress).

3.6 A decontamination program shall be established for personnel leaving the disposal site.

3.7 The Site Health and Safety Plan shall be consistent with and work performed shall comply with the following:

3.7.1 USEPA - Occupational Health and Safety Manual

3.7.2 USEPA Order 1440.1 - Respiratory Protection

3.7.3 USEPA Order 1440.3 - Health and Safety Requirements for Employees Engaged in Field Activities

3.7.4 USEPA - Interim Standard Operating Safety Guides

3.7.5 Illinois Occupational Safety and Health Act

3.7.6 Actual disposal site conditions

## 4.0 Quality Assurance Project Plan

4.1 The Consultant shall develop a quality assurance project plan for the sampling, analysis, and data handling of the various soil and water samples. The plan shall be consistent with the requirements of:

4.1.1 USEPA QAMS-005/80 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans

4.2 The Consultant shall use acceptable Q.A./Q.C. programs. Specific items of concern that shall be satisfactorily complied with as follows:

4.2.1 Equipment shall be maintained and calibrated at regular intervals.

4.2.2 Procedures for sampling shall follow ASTM methods and/or adhere to EPA guidelines.

4.2.3 Standard field notebooks shall be used during sampling to record all information and observations.

4.2.4 Work shall be carried out only by qualified personnel.

4.2.5 Sample custody shall be documented by the Consultant's procedures while in-house, and by EPA guidelines outlined "Test Methods for Evaluating Solids Waste (EPA-SW-846, 1980)" as necessary. In addition overall sample custody shall comply with paragraph 4.1.1 above.

## 5.0 Field Protocols

The Consultant shall develop field protocols for various situations that may occur during the field phase. Situations to plan for but not limited to:

5.1 Decontamination of equipment, and sampling equipment between sampling.

5.2 Disposal procedures of any contaminated soils, ground waters, etc.

5.3 Hole abandonment procedures.

5.4 Procedures to be taken if any dangerous vapors, ie. xylene, etc., are encountered during drilling.

## 6.0 Sub-Contractors Procurement

The Consultant shall submit the required documents to their prospective sub-contractors for bidding various work to be sub-contracted. Consultant shall submit the name/s of sub-contractor/s and scope of work to be performed for approval by the Owner.

## 7.0 Site Safety Decontamination Facilities

7.1 The Consultant shall provide site safety and decontamination facilities. A combination decontamination and office trailer shall be supplied for site use by all field personnel. In addition, personal air samplers shall be worn by all field personnel to monitor airborne asbestos. Filters will be analyzed for asbestos fibers.

7.2 It is assumed that the site health and safety assessment recommends Level C protection for all on-site activities. The Consultant shall use disposable personal protective clothing and decontamination materials.

## 8.0 Site Survey

8.1 The Consultant shall retain a registered Illinois land surveyor to provide temporary on-site bench marks from which drill crews shall establish locations and surface elevations of each boring. The survey tolerance shall be as follows:

| | | |
|---|---|---|
| 8.1.1 | All boring locations: | Horiz. - ± 1 ft. |
| 8.1.2 | Ground water monitoring wells, | Vert. Elev - ± 0.01 ft. |
| 8.1.3 | Soil borings, | Vert. Elev. - ± 0.1 ft |

8.2 The actual location of the borings per drawings to be within one (1) foot $\pm$ in any horizontal direction due to ongoing activities at the site and/or nature of the waste fill material.

9.0 Soil Sampling and Analysis

9.1 The Consultant shall determine whether the surface, near surface, and subsurface soils are contaminated with hazardous substances. This shall include samples from both fill materials and natural underlying soils where practical.

9.1.1 Disposal on-site and perimeter (non-disposal areas) soil samples shall be analyzed for the presence of substances identified in paragraph 9.2. Representative surface and near-surface soil samples could be obtained with a solid-stem hand auger.

9.1.2 Surface and near-surface samples shall be taken at 0.0 to 0.5 foot and 1.0 to 1.5 feet typically at four (4) places at each location. At each of these boring locations, a composite sample shall be made of the four surface samples and another composite sample shall be made of the four near-surface samples. The proposed on-site and perimeter sampling locations are shown on contract drawings. Sampling equipment shall be decontaminated between samples.

9.1.3 From the disposal on-site soil borings, representative subsurface samples shall be obtained at two and one-half (2.5) foot intervals in the waste fill material using a standard split-spoon sampler until the natural ground is reached. In order to minimize the possibility of contaminating the underlying natural soils, the soil borings through the waste fill material shall, to the extent possible, not penetrate into the underlying natural soils. Upon field determination of the total depth of waste fill material at each boring hole, USEPA will determine, in consultation with the Owner, the percentage of the fill samples to be analyzed. The remainder shall be properly stored for future analysis if required.

9.1.4 Continuous sampling from the perimeter (non-disposal areas) soil boring holes shall be obtained to a depth of thirty (30) feet below the lowest level of waste deposition.

9.1.5 The soil borings shall be made with a standard 6 1/4" O.D. hollow stem auger. Sample shall be obtained using split spoon sampling or thin wall tubes, as field conditions permit, following ASTM procedures.

9.1.6 All sampling and testing shall conform to guidelines in the User's Guide to the USEPA Contract Laboratory Program (CLP) prepared by the Sample Management Office of CLP and published in August 1982.

9.1.7 Cuttings can be disposed of on site.

9.1.8 All samples and data obtained should be stored for twelve (12) months after completion of laboratory work. The Owner shall be notified prior to disposing of the samples.

9.2 Soil samples would be analyzed for:

9.2.1 Asbestos fibers

9.2.2 Engineering properties (sieve, specific gravity, moisture content, Atterberg limits, permeability).

9.2.3 Inorganic Analysis Data Sheet (Table 1)

9.2.4 Organic Analysis Data Sheet (Table 2)

Non-priority pollutant hazardous substances list compounds may be deleted except for Xylene.

9.2.5 Thiram

9.3 A technical memorandum describing the soil sampling and analysis program shall be prepared. The technical memorandum shall include a description of the sampling procedure, a summary of the laboratory test results, and copies of the laboratory data sheets. Five (5) copies of the technical memorandum shall be submitted to the Owner and Illinois EPA, and USEPA.

9.4 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

9.4.1 Three hundred (300) lineal feet (10 boring locations x 30' depth each) of soil borings. This will include one hundred and twenty (120) lineal feet of continuous soil sampling, 4 perimeter (non-disposal areas) holes x 30' depth.

9.4.2 Two (2) composite samples from each soil boring location shall be taken per paragraphs 9.1.1 and 9.1.2.

9.4.3 Ten (10) surface and near-surface soil samples listed in paragraph 9.4.2 above shall be analyzed per paragraph 9.2.

9.4.4 Seventy-six (76) sub-surface soil samples shall be taken. Breakdown of these samples as follows.

9.4.4.1 Seventy-two (72) samples from six (6) soil boring holes in the waste fill material, 12 samples per hole (30' depth - 2.5' intervals).

9.4.4.2 Four (4) samples, one sample each from the perimeter (disposal off-site) soil boring holes.

9.4.5 Sixteen (16) subsurface soil samples shall be analyzed per paragraph 9.2. The samples shall consist of twelve (12) waste fill material samples (2 samples per 6 disposal on-site holes) and four (4) natural soil samples per paragraph 9.4.4.2 above.

9.4.6 Site sampling team consists of one engineering geologist/geotechnical engineer/hydrogeologist, and two technicians.

## 10.0 Groundwater Monitoring Well Installation

10.1 The Consultant shall install groundwater monitoring wells at locations shown on the contract drawings.

10.2 These wells shall be used to determine whether the near surface groundwater is contaminated with hazardous substances.

10.2.1 Groundwater monitoring wells will not be drilled through waste fill material and/or installed in the disposal on-site area.

10.2.2 The perimeter (non-disposal areas) wells shall be drilled and screened so as to monitor the upper most portion of the shallow aquifer..

10.3 Screen positions shall be determined in the field based on the subsurface conditions.

10.4 The monitoring wells shall be constructed in compliance with Federal and State regulations. Well drilling and installation shall be logged and inspected by a qualified hydrogeologist/geotechnical engineer/engineering geologist.

General requirements are:

10.4.1 All drilling equipment, pipe, and materials shall be decontaminated before drilling.

10.4.2 Eight (8) inch minimum diameter boreholes shall be drilled with a hollow stem auger or cable tool drill rig.

10.4.3 A continuous sample of the natural ground shall be taken in each well for the purpose of a geological log. No soil samples will be required for chemical nor engineering properties analyses from the ground water monitoring well sites.

10.4.4 The monitoring wells shall be constructed as per details attached to these specifications.

10.4.5 Wells shall be developed with air, bailing, or surging techniques after installation.

10.4.6 All drilling equipment, pipe, and materials shall be decontaminated before proceeding to the next hole.

10.4.7 Top of casing and stable groundwater elevations shall be obtained for all wells to within 0.01 foot.

10.4.8 Field hydraulic conductivity tests shall be conducted on some wells if aquifer characteristics permit.

10.4.9 All groundwater samples and data obtained shall be stored for twelve (12) months after completion of laboratory work. The Owner shall be notified prior to disposing of the samples.

10.5 A technical memorandum describing the groundwater monitoring well installation shall be prepared. The technical memorandum shall include a description of the drilling, installation of wells, a summary of the field test results, and a map of the water table elevations (a potentiometric ground water map). Five (5) copies of the technical memorandum shall be submitted to the Owner, Illinois EPA, and USEPA.

10.6 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

10.6.1 One hundred and fifty (150) lineal feet of drilling and well installation, five (5) perimeter (disposal off-site) wells x 30 lf each. This includes one hundred and fifty (150) lineal feet of continuous soil sampling.

10.6.2 Site drilling and sampling team consists of one engineering geologist/geotechnical engineer/ hydrogeologist, and two technicians.

10.6.3 Field hydraulic conductivity tests and groundwater elevation measurements shall be performed by site sampling team personnel.

10.6.4 All water used or discharged in the drilling process and all drill cuttings can be disposed of on site.

## 11.0 Groundwater Quality Sampling and Anaylsis

11.1 The Consultant shall provide water quality data for determining whether the groundwater is contaminated with hazardous substances. Water quality samples shall be analyzed for the presence of substances identified in paragraph 11.2. Representative samples shall be obtained from each new monitoring well. Sampling equipment shall be decontaminated between samples. All sampling and testing shall conform to guidelines in the User's Guide to the US EPA CLP prepared by the Sample Management Office of CLP and published in August 1982.

11.2 Groundwater samples shall be analyzed for:

11.2.1 Asbestos fibers

11.2.2 Inorganic Analysis Data Sheet (Table 1)

11.2.3 Organic Analysis Data Sheet (Table 2)

Non-priority pollutant hazardous substances list compounds may be deleted except of Xylene.

11.2.4 Thiram

11.3 A technical memorandum describing the groundwater sampling and analysis program shall be prepared. The memorandum shall recommend whether or not additional groundwater wells and sampling may be required based on the findings. The technical memorandum shall include a description of the sampling procedure, a summary of the laboratory test results, and copies of the laboratory data sheets. Five (5) copies of the technical memorandum shall be submitted to the Owner, Illinois EPA, and USEPA.

11.4 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

11.4.1 Two (2) groundwater samples shall be taken from each well. Five (5) groundwater samples , one from each well, shall be analyzed per paragraph 11.2.

11.4.2 Site sampling team consists of one geotechnical engineer/engineering geologist/hydrogeologist, and two technicians.

11.4.3 All water purged from the wells during the sampling can be disposed of on site.

TABLE 1

| Sample No. |
| --- |
| |

# INORGANICS ANALYSIS DATA SHEET

LAB NAME ______________________ CASE NO. ______________________

LAB SAMPLE ID. NO. ______________________ QC REPORT NO. ______________________

## TASK 1 (Elements to be Identified and Measured)

| | ug/l or mg/kg (circle one) | | ug/l or mg/kg (circle one) |
| --- | --- | --- | --- |
| 1. Aluminum | | 10. Zinc | |
| 2. Chromium | | 11. Boron | |
| 3. Barium | | 12. Vanadium | |
| 4. Beryllium | | 13. Silver | |
| 5. Cobalt | | | |
| 6. Copper | | | |
| 7. Iron | | | |
| 8. Nickel | | | |
| 9. Manganese | | | |

## TASK 2 (Elements to be Identified and Measured)

| | ug/l or mg/kg (circle one) | | ug/l or mg/kg (circle one) |
| --- | --- | --- | --- |
| 1. Arsenic | | 5. Mercury | |
| 2. Antimony | | 6. Tin | |
| 3. Selenium | | 7. Cadmium | |
| 4. Thallium | | 8. Lead | |

## TASK 3 (Elements to be Identified and Measured)

| | ug/l or mg/kg (circle one) |
| --- | --- |
| 1. Ammonia | |
| 2. Cyanide | |
| 3. Sulfide | |

COMMENTS:

recycled paper

TABLE 2

| Sample Number |
|---|
| |

## ORGANICS ANALYSIS DATA SHEET

Laboratory Name: ______________________ Case No: ______________________

Lab Sample I.D. No: ______________________ QC Report No: ______________________

Multiply Detection Limits by 1 ☐ or 10 ☐ (Check Box for Appropriate Factor)

### ACID COMPOUNDS

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (21A) | 88-06-2 | 2,4,6-trichlorophenol | |
| (22A) | 59-50-7 | p-chloro-m-cresol | |
| (24A) | 95-57-8 | 2-chlorophenol | |
| (31A) | 120-83-2 | 2,4-dichlorophenol | |
| (34A) | 105-67-9 | 2,4-dimethylphenol | |
| (57A) | 88-75-5 | 2-nitrophenol | |
| (58A) | 100-02-7 | 4-nitrophenol | |
| (59A) | 51-28-5 | 2,4-dinitrophenol | |
| (60A) | 534-52-1 | 4,6-dinitro-2-methylphenol | |
| (64A) | 87-86-5 | pentachlorophenol | |
| (65A) | 108-95-2 | phenol | |

### BASE/NEUTRAL COMPOUNDS

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (1B) | 83-32-9 | acenaphthene | |
| (5B) | 92-87-5 | benzidine | |
| (8B) | 120-82-1 | 1,2,4-trichlorobenzene | |
| (9B) | 118-74-1 | hexachlorobenzene | |
| (12B) | 67-72-1 | hexachloroethane | |
| (18B) | 111-44-4 | bis(2-chloroethyl)ether | |
| (20B) | 91-58-7 | 2-chloronaphthalene | |
| (25B) | 95-50-1 | 1,2-dichlorobenzene | |
| (26B) | 541-73-1 | 1,3-dichlorobenzene | |
| (27B) | 106-46-7 | 1,4-dichlorobenzene | |
| (28B) | 91-94-1 | 3,3'-dichlorobenzidine | |
| (35B) | 121-14-2 | 2,4-dinitrotoluene | |
| (36B) | 606-20-2 | 2,6-dinitrotoluene | |
| (37B) | 122-66-7 | 1,2-diphenylhydrazine | |
| (39B) | 206-44-0 | fluoranthene | |
| (40B) | 7005-72-3 | 4-chlorophenyl phenyl ether | |
| (41B) | 101-55-3 | 4-bromophenyl phenyl ether | |
| (42B) | 39638-32-9 | bis (2-chloroisopropyl) ether | |
| (43B) | 111-91-1 | bis (2-chloroethoxy) methane | |
| (52B) | 87-68-3 | hexachlorobutadiene | |
| (53B) | 77-47-4 | hexachlorocyclopentadiene | |
| (54B) | 78-59-1 | isophorone | |
| (55B) | 91-20-3 | naphthalene | |
| (56B) | 98-95-3 | nitrobenzene | |
| (62B) | 86-30-6 | N-nitrosodiphenylamine | |
| (63B) | 621-64-7 | N-nitrosodipropylamine | |
| (66B) | 117-81-7 | bis (2-ethylhexyl) phthalate | |
| (67B) | 85-68-7 | benzyl butyl phthalate | |
| (68B) | 84-74-2 | di-n-butyl phthalate | |
| (69B) | 117-84-0 | di-n-octyl phthalate | |
| (70B) | 84-66-2 | diethyl phthalate | |
| (71B) | 131-11-3 | dimethyl phthalate | |
| (72B) | 56-55-3 | benzo(a)anthracene | |

### BASE/NEUTRAL COMPOUNDS

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (73B) | 50-32-8 | benzo(a)pyrene | |
| (74B) | 205-99-2 | benzo(b)fluoranthene | |
| (75B) | 207-08-9 | benzo(k)fluoranthene | |
| (76B) | 218-01-9 | chrysene | |
| (77B) | 208-96-8 | acenaphthylene | |
| (78B) | 120-12-7 | anthracene | |
| (79B) | 191-24-2 | benzo(ghi)perylene | |
| (80B) | 86-73-7 | fluorene | |
| (81B) | 85-01-8 | phenanthrene | |
| (82B) | 53-70-3 | dibenzo(a,h)anthracene | |
| (83B) | 193-39-5 | indeno(1,2,3-cd)pyrene | |
| (84B) | 129-00-0 | pyrene | |

### VOLATILES

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (2V) | 107-02-8 | acrolein | |
| (3V) | 107-13-1 | acrylonitrile | |
| (4V) | 71-43-2 | benzene | |
| (6V) | 56-23-5 | carbon tetrachloride | |
| (7V) | 108-90-7 | chlorobenzene | |
| (10V) | 107-06-2 | 1,2-dichloroethane | |
| (11V) | 71-55-6 | 1,1,1-trichloroethane | |
| (13V) | 75-34-3 | 1,1-dichloroethane | |
| (14V) | 79-00-5 | 1,1,2-trichloroethane | |
| (15V) | 79-34-5 | 1,1,2,2-tetrachloroethane | |
| (16V) | 75-00-3 | chloroethane | |
| (19V) | 110-75-8 | 2-chloroethylvinyl ether | |
| (23V) | 67-66-3 | chloroform | |
| (29V) | 75-35-4 | 1,1-dichloroethene | |
| (30V) | 156-60-5 | trans-1,2-dichloroethene | |
| (32V) | 78-87-5 | 1,2-dichloropropane | |
| (33V) | 10061-02-6 | trans-1,3-dichloropropene | |
| | 10061-01-05 | cis-1,3-dichloropropene | |
| (38V) | 100-41-4 | ethylbenzene | |
| (44V) | 75-09-2 | methylene chloride | |
| (45V) | 74-87-3 | chloromethane | |
| (46V) | 74-83-9 | bromomethane | |
| (47V) | 75-25-2 | bromoform | |
| (48V) | 75-27-4 | bromodichloromethane | |
| (49V) | 75-69-4 | fluorotrichloromethane | |
| (50V) | 75-71-8 | dichlorodifluoromethane | |
| (51V) | 124-48-1 | chlorodibromomethane | |
| (85V) | 127-18-4 | tetrachloroethene | |
| (86V) | 108-88-3 | toluene | |
| (87V) | 79-01-6 | trichloroethene | |
| (88V) | 75-01-4 | vinyl chloride | |

TABLE 2

# ORGANICS ANALYSIS DATA SHEET

Sample Number

Laboratory Name: ____________ Case No: ____________

Lab Sample I.D. No: ____________ QC Report No: ____________

Multiply Detection Limits by 1 ☐ or 10 ☐ (Check Box for Appropriate Factor)

## PESTICIDES

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (89P) | 309-00-2 | aldrin | |
| (90P) | 60-57-1 | dieldrin | |
| (91P) | 57-74-9 | chlordane | |
| (92P) | 50-29-3 | 4,4'-DDT | |
| (93P) | 72-55-9 | 4,4'-DDE | |
| (94P) | 72-54-8 | 4,4'-DDD | |
| (95P) | 115-29-7 | α-endosulfan | |
| (96P) | 115-29-7 | β-endosulfan | |
| (97P) | 1031-07-8 | endosulfan sulfate | |
| (98P) | 72-20-8 | endrin | |
| (99P) | 7421-93-4 | endrin aldehyde | |
| (100P) | 76-44-8 | heptachlor | |
| (101P) | 1024-57-3 | heptachlor epoxide | |
| (102P) | 319-84-6 | α-BHC | |

## PESTICIDES

| PP # | CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|---|
| (103P) | 319-85-7 | β-BHC | |
| (104P) | 319-86-8 | δ-BHC | |
| (105P) | 58-89-9 | γ-BHC (lindane) | |
| (106P) | 53469-21-9 | PCB-1242 | |
| (107P) | 11097-69-1 | PCB-1254 | |
| (108P) | 11104-28-2 | PCB-1221 | |
| (109P) | 11141-16-5 | PCB-1232 | |
| (110P) | 12672-29-6 | PCB-1248 | |
| (111P) | 11096-82-5 | PCB-1260 | |
| (112P) | 12674-11-2 | PCB-1016 | |
| (113P) | 8001-35-2 | toxaphene | |

## DIOXINS

| PP # | CAS # | | |
|---|---|---|---|
| (129B) | 1746-01-6 | 2,3,7,8-tetrachlorodibenzo-p-dioxin | |

## Non-Priority Pollutant Hazardous Substances List Compounds

### ACID COMPOUNDS

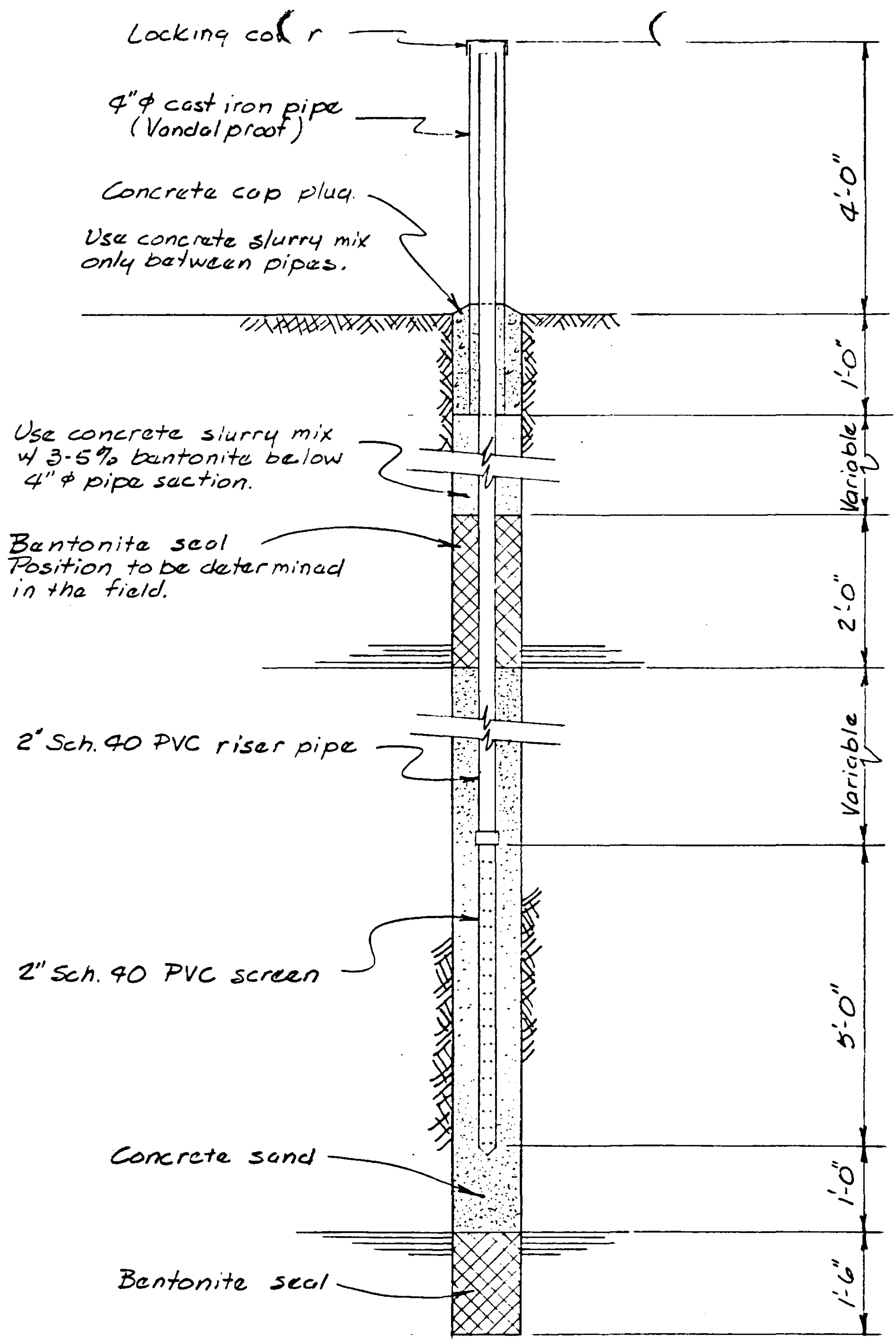
| CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|
| 65-85-0 | benzoic acid | |
| 95-48-7 | 2-methylphenol | |
| 108-39-4 | 4-methylphenol | |
| 95-95-4 | 2,4,5-trichlorophenol | |

### BASE/NEUTRAL COMPOUNDS

| CAS # | | |
|---|---|---|
| 62-53-3 | aniline | |
| 100-51-6 | benzyl alcohol | |
| 106-47-8 | 4-chloroaniline | |
| 132-64-9 | dibenzofuran | |
| 91-57-6 | 2-methylnaphthalene | |
| 88-74-4 | 2-nitroaniline | |
| 99-09-2 | 3-nitroaniline | |
| 100-01-6 | 4-nitroaniline | |

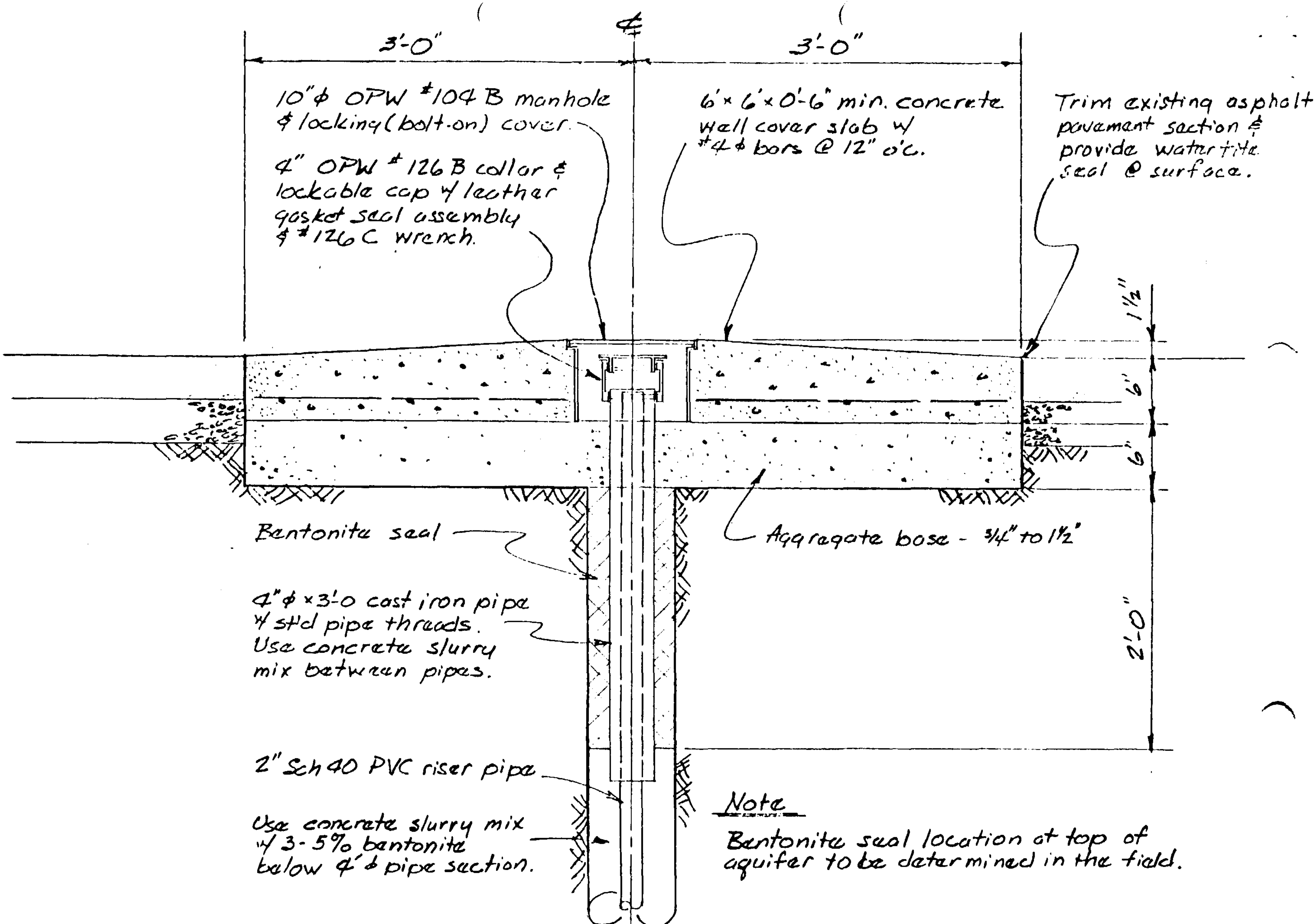
### VOLATILES

| CAS # | | ug/l or ug/kg (circle one) |
|---|---|---|
| 67-64-1 | acetone | |
| 78-93-3 | 2-butanone | |
| 75-15-0 | carbondisulfide | |
| 519-78-6 | 2-hexanone | |
| 108-10-1 | 4-methyl-2-pentanone | |
| 100-42-5 | styrene | |
| 108-05-4 | vinyl acetate | |
| 95-47-6 | o-xylene | |




PROPOSED GROUNDWATER MONITORING WELL

HW/23Mar'84




# PROPOSED GROUNDWATER MONITORING WELL

Typical Detail @ Grade in Paved Areas

HD/23Mar84

EXHIBIT 3

## A. Remedial Investigation Report

The objectives of the RI report will be to document the procedures and results of the detailed site characterization studies. The RI report will include a discussion of the following:

a. Description of air/soil/sediment sampling procedure;

b. Summary of air/soil/sediment laboratory test results;

c. Copies of air/soil/sediment laboratory data sheets;

d. Description of drilling and installation of wells;

e. Summary of well field test results, including a potentiometric map;

f. Copies of boring logs;

g. Description of groundwater sampling procedure;

h. Summary of groundwater test results;

i. Copies of groundwater laboratory data sheets; and

j. An endangerment assessment, including the following:

(1) <u>Objectives</u>

The assessment has two objectives: (1) to provide an evaluation of the level of endangerment to human health and the environment posed by potential or actual release of hazardous substances from the Disposal Area and (2) to provide a basis to differentiate among alternatives in selecting recommended remedial measures. The assessment will involve three steps: identifying contaminants (amount and form), exposure pathways, environmental fate and transport mechanisms, and receptors; researching hazard information on the contaminants of interest; and evaluating the overall risk to the environment and public health and welfare.

(2) Identify Contaminants, Pathways, and Receptors

Data collected during the field investigations shall be reviewed to identify contaminants which appear to be present in significant concentrations. The amount and form of these contaminants shall be quantified to the extent possible. Possible pathways for contaminant migration shall also be identified. Factors to be considered in evaluating the direction and extent of potential contaminant migration shall include soil permeability, depth to the saturated zone, hydraulic gradients, waste characteristics, meteorological factors, the effects of natural or man-made barriers, the experiences and approaches used in similar situations by State and Federal agencies and private parties, and environmental effects and welfare concerns. Receptors which may be impacted by the contaminants shall be identified. Receptors may include significant habitats, as well as people near the site who breathe the air or use groundwater as a potable water source. The human population at risk (i.e., those having present or potential contact with contaminants from the site) shall be identified.

(3) Research Hazard Information

A literature review shall be conducted on the hazardous properties of the contaminants of greatest interest, identified in Subtask 2) above. If available, toxicity profiles, published criteria, and other data on the specific compounds or families of compounds shall be collected and synthesized. Criteria for contaminants may include National Interim Primary and Secondary Drinking Water Standards, NIOSH reports, Ambient Water Quality Criteria developed by EPA, and existing and published proposed criteria for asbestos in the workplace and the environment.

(4) Evaluate Overall Risks

Using information developed in Subtasks 2) and 3), the potential impacts of potential or actual release of hazardous substances from the Disposal Area on human health and the environment shall be evaluated. To the extent possible, expected contaminant distributions on land, in air, and in groundwater and surface water shall be described. If available data are not sufficient to complete a detailed quantitative evaluation, predictions of contaminant distributions may be qualitative, sufficient to provide a general evaluation of the risks posed by the site. The assessment shall describe the number of receptors affected, levels of contaminant exposure, and associated public health risks and environmental impact.

k. Discussion of project objectives for evaluation in the FS.

## B. Alternative Remedial Actions Evaluation

The objectives of the alternative remedial actions evaluation task will be to evaluate alternative remedial actions on the basis of economic, environmental, and engineering criteria and to select an alternative or combination of alternatives for conceptual design and implementation. The level of detail to be used in these evaluations will identify only comparative or relative differences among alternatives. A schedule for conducting this evaluation shall be submitted to U.S. EPA for approval within 14 days of approval of the RI report.

B-1: Description of Proposed Response. The objective of this section will be to summarize the site background information and the nature and extent of the problem. In consultation with USEPA the site-specific objectives, screening criteria, and proposed response would be developed. Screening criteria shall include the following:

- Economic--both capital and operating costs will be considered;
- Environmental Effects--any adverse impacts on health and welfare or the surrounding environment which might be associated with an alternative will be considered;
- Engineering--each alternative must be technically feasible, applicable to project needs, and must be a reliable method of solving the problem.

B-2: Development of Alternatives. The objective of this section will be to compile a list of potential source control and off-site remedial action alternatives. The alternatives would be based on site-specific objectives and public health and welfare and environmental concerns. This list shall be submitted to U.S. EPA prior to initial screening of the alternatives.

B-3: Initial Screening of Alternatives. The objective of this section will be to evaluate alternative remedial actions based on cost, effects of alternative, and acceptable engineering practices. Alternatives that far exceed the costs of other alternatives evaluated and do not provide substantially greater public health or environmental benefit would be excluded from further consideration. Only those alternatives that effectively contribute to the protection of public health, welfare, or the environment would be considered further. Alternatives must also be considered feasible, be applicable to the problem, and represent a reliable means of addressing the problem. A list of alternatives for more detailed evaluation shall be developed and submitted to U.S. EPA for approval.

B-4: Detailed Analysis of Alternatives. The objective of this section will be to develop engineering details on the remaining alternatives and Order-of-Magnitude cost estimates. These engineering details would include alternative descriptions and conceptual site layout drawings, operation and maintenance requirements, a preliminary implementation schedule, safety requirements, and special engineering considerations. Another objective would be to assess each alternative in terms of the extent to which it is expected to effectively mitigate and minimize damage to, and provide adequate protection of, public health, welfare, and the environment, relative to the other alternatives analyzed. A determination will be made as to whether the existing data are adequate to fully evaluate each of the options. If the data are found to be inadequate, additional studies of the site may be necessary.

Rankings of the remedial action options shall be formulated for each of the economic, environmental, and engineering assessment categories. The economic assessment shall compare remedial action alternatives according to:

- Order-of-magnitude construction and operation and maintenance costs;
- Detailed cost estimation, including distribution of costs over time and present worth analysis.

The environmental assessment shall compare alternatives according to:

- The known adverse environmental effects of the alternatives;
- The effectiveness of measures designed to mitigate adverse effects, and costs of mitigation;
- The adequacy of source control measures;
- The effectiveness of offsite control measures, if needed;
- The permitting and other legal and institutional requirements.

The engineering assessment shall compare alternatives according to the following factors, with emphasis on the use of established technology:

- Reliability;
- Health and safety risks of construction and operation;
- Feasibility of construction and operation;
- Offsite transportation and disposal requirements, if appropriate to the remaining alternatives;
- Compliance with applicable regulations.

An overall ranking will be prepared to determine the most cost-effective alternative for the site. (i.e. the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, and the environment.)

C. Feasibility Study Report

The objective of the FS report will be to compile and describe methods, results, and conclusions of the alternative remedial actions evaluation task. The report would incorporate and include the following:

a. Summary of the hazards and potential hazards for which corrective action is required;

b. Detailed analysis of alternative technologies which can be employed to effectuate the corrective action, such analyses to include those items outlined in 40 C.F.R. 300.68(i)(2)(A) through (E) of the National Contingency Plan;

c. Description of all studies performed or evaluated to confirm the applicability of each alternative assessed;

d. Unit cost estimates for each alternative;

e. Operation and maintenance requirements with cost estimates, for each alternative;

f. Long-term integrity for each alternative;

g. Timeliness of implementation for each alternative; and

h. A discussion of conformity to federal, state, and local laws and regulations, for each alternative.